

**GOVERNMENT OF INDIA
DEPARTMENT OF SPACE
ISRO SATELLITE CENTRE (ISAC)
AIRPORT ROAD, VIMANAPURA POST
BANGALORE-560 0017.**

TENDER NOTICE NO. 17 DATED 11.03.2011

On behalf of President of India, Head, Purchase & Stores, ISRO Satellite Centre (ISAC), Bangalore 560 017 invites sealed tenders for the supply of the following items:

SL. NO	TENDER REFERENCE	BRIEF DESCRIPTION	QTY	TENDER FEE INCL OF S.TAX Rs. Ps.
01	ISGE 2010 018948	ALUMINIUM ALLOY PLATES	(AS PER DOCUMENT)	Rs. 227/-
02	ISIR 2010 019007	LVDS DEVICES (SPACE GRADE)	(AS PER DOCUMENT)	Rs. 227/-
03	ISCO 2010019020	PROVIDING TECHNICAL SUPPORT SERVICES FOR CIVIL WORKS	(AS PER DOCUMENT)	Rs. 227/-
04	ISIR 2010019090	SPACE GRADE BAND PASS FILTER	(AS PER DOCUMENT)	Rs.227/-
05	ISDO 2010019094	PROVIDING MECHANICAL SUPPORT FOR FITTING, TURNING ETC.,	(AS PER DOCUMENT)	Rs. 227/-

06	ISIR 2010019209	SPACE GRADE RAD HARD ANTIFUSE FPGAS	(AS PER DOCUMENT)	Rs. 227/-
07	ISIR 2010019211	RADIATION CROSS LINKED ETFE INSULATED SPACE GRADE WIRES	(AS PER DOCUMENT)	Rs. 227/-
08	ISGE 2010 019275	VECTOR NETWORK ANALYSER	01 NO.	Rs. 227/-

TWO PART TENDERS

09	ISGE 2010019117	192 CHANNEL ACOUSTIC DATA ACQUISITION SYSTEM	01 NO.	Rs. 227/-
10	ISGE 2010019132	THERMAL FABRICATION AND IMPLEMENTATION OF VARIOUS ELEMENTS	(AS PER DOCUMENT)	Rs 227/-
11	ISIP 2010019251	FORCE TRANSDUCERS AND DIGITAL PRECISION MEASURING AMPLIFIER	(AS PER DOCUMENT)	Rs. 227/-
12	ISIP 2010019250	LOW PROFILE WEIGHING SCALE	(AS PER DOCUMENT)	Rs. 227/-

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1. SL. NO. 01 TO 05: FOR SUBMISSION OF TENDER: 25TH APRIL 2011 AT 1600HRS (IST)
OPENING OF TENDER: 26TH APRIL 2011 AT 1000HRS (IST)
2. SL. NO. 06 TO 08: FOR SUBMISSION OF TENDER: 28TH APRIL 2011 AT 1600HRS (IST)
OPENING OF TENDER: 29TH APRIL 2011 AT 1000HRS (IST)
3. SL. NO. 09 TO 12: FOR SUBMISSION OF TENDER: 02ND MAY 2011 AT 1600HRS (IST)
OPENING OF TENDER: 03RD MAY 2011 AT 1000HRS (IST)

**NOTE: TWO PART TENDER SYSTEM IS APPLICABLE FOR SL.NO. 09, 10, 11,
& 12 ONLY. INSTRUCTIONS ARE PART OF THE TENDER
DOCUMENTS.**

NOTE:

1. Tender documents will be hosted shortly on ISRO Web site of www.isro.gov.in. Interested tenderers may, at their option, download the tender documents from website and submit offers along with prescribed tender cost (in form of Bank Draft) as per details in the tender notification. The Demand Draft should be sent in a separate cover with a covering letter along with the cover containing the quotation.
2. Tender fee shall be payable only in the form of bank draft drawn in favour of Accounts Officer, ISRO Satellite Centre, payable at Bangalore. No other mode of payment for tender fee is acceptable.
3. Vendors/firms name and tender no. shall be indicated on the reverse side of the Demand Draft.
4. While requesting for tender documents, please do not superscribe tender number and due date on the envelop. Instead indicate "Request for Tender Documents".
5. Detailed specification, terms and conditions are furnished in the tender documents.
6. DD should not be dated prior to the date of advertisement / intimation / website. Separate requests and demand drafts shall be sent for each tender document.
7. ISAC will not be responsible for non-receipt of tender documents/offers due to postal delay / loss in transit.
8. Quotations received without payment of tender fee will be treated as unsolicited.
9. Indian agents while quoting on behalf of their principals are requested to provide necessary authorisation letter from their Principals.
10. The offer should be valid for the period of Ninety days from the date of opening.
11. Quotations received after the due date and time will not be considered.
12. While submitting your offer please superscribe tender no and due date on the envelope. Addressed to Head Purchase & Stores, ISRO Satellite Centre, Airport Road, Vimanapura Post, Bangalore-560 017.
13. If tender opening date happens to be public holiday tender will be opened on the next working day & interested Vendors may depute their Representatives to attend the Public Tender Opening.
14. Request for the extension of the due date will not be considered.
15. Head, Purchase and Stores, ISAC reserves the right to accept or reject any tenders in part or full without assigning any reasons thereof.
16. Tenderers who do not utilise the website shown at clause 01 above can also procure the Tender documents from Purchase & Stores Officer, Purchase Division, ISRO Satellite Centre, Airport Road, Vimanapura Post, Bangalore-560 017, INDIA on payment of Non-refundable Tender fee as indicated above, on all working days between **1400Hrs to 1600Hrs**.

INSTRUCTIONS TO TENDERERS	SUPPLIER'S COMMENTS/COMPLI
1. The Tenderers should submit quotations in duplicate in a sealed envelop, superscribing the Tender No. and due date of opening and completed in all respects with technical specifications, including pamphlets and catalogues.	
2. A Proforma Invoice may also be given which should contain the following information:-	
a) The FOB value, the C & F Value for import by Sea-Freight/ Air Freight upto and for air parcel post upto Bangalore-17 should be separately indicated.	
b) Agency Commission: The amount of commission included in the price and payable to the Indian Agents of the Contractor shall be directly to the Indian Agents by the purchaser in equivalent Indian Rupees on the basis of an invoice from him applying T.T. buying rate of exchange ruling on the date of placement of the Purchase Order and which shall not be subject to any further exchange variations. This payment will be released to the Indian Agents within 30 days from the date of acceptance of goods.	
c) The Contractor shall invoice only for the net amount payable to him, after deducting the amount of Agency Commission included in the invoice which would be paid to the Indian Agents directly by the Purchaser. However, the contractor's invoice should separately reflect the amount of commission payable to his Indian Agent.	
d) The earliest delivery period and country of origin of the Stores.	
e) Banker's name and address of the contractor.	
f) The approximate net and gross weight and dimensions of packages/cases.	
g) Recommended spares for satisfactory operation for a minimum period of one year.	
h) Details of any technical service, if required for erection, assembly, commissioning and demonstration.	
3. The FOB and C & F prices quoted should be inclusive of all taxes, levies, duties arising in the tender's country.	
4. The offer should be valid for a minimum period of 120 days from the due date of opening of the tender.	
5. Samples, if called for should be sent free of all charges.	
6. Late tenders will not be considered. Quotations by cable, fax	

or telex must be followed by detailed offers, to reach within	
15 days.	
7. Offers made by Indian Agents on behalf of their Principals, should be supported by the Proforma Invoice of their Principals.	
8. The details of Import License will be furnished in the Purchase Order.	
9. The Authority of person signing the tender, if called for, shall be produced.	
10. Instruction/operation manual containing all assembly details including wiring diagrams should be sent wherever necessary in duplicate. All documents/correspondence should be in English Language only.	
11. The Purchaser reserves the right to accept or reject the lowest or any other offer in whole or in part without assigning any reason.	
12. It is expressly agreed that the acceptance of the stores contracted for is subject to final approval in writing by the Purchaser.	
13 a. Part shipment is not allowed unless specifically agreed to by us.	
b. As far as possible, stores should be despatched by Indian Flagged Vessels/ Air India or through any Agency nominated by us.	
14. Inspection/Test Certificates should be provided for the goods	
any inspection by Lloyds or any other testing agency is considered necessary, it shall be arranged by Contractors.	
15. Where erection or assembly or commissioning is a part of the contract is should be done immediately on notification. The Contractor shall be responsible for any loss / damages sustained due to delay in fulfilling this responsibility.	
16. For items having shelf life / those with maximum shelf should be supplied, if order is placed.	
TERMS AND CONDITIONS	
1. DEFINITIONS:	
a) The term 'Purchaser' shall mean the President of India or his successors or assigns	
b) The term 'contractor' shall mean the person firm or company with whom or with which the order for the supply of stores is placed and shall be deemed to include the Contractor's representatives heirs, executors and administrators unless excluded by the contract	
c) The term Purchase Order shall mean, the communication authorised intimating the acceptance on behalf of the purchaser on the terms and conditions mentioned or	

referred to in the said communication accepting Tender or offer of the Contractor for supply of stores or plant or machinery or part thereof.	
d) The term "stores" shall mean, what the Contractor agrees to supply under the contract as specified in the purchase order.	
2. PRICES shall be indicated only in PART-II	
Tenders offering firm prices will be preferred. Where a price variation clause is insisted upon by a tenderer quotations with a reasonable ceiling should be submitted. Such offers should invariably be supported by the base price taken into account at the time of tendering and also the formula for any such variations.	
3. TERMS OF PAYMENT	
3.1 Being a Department of Government of India, the normal terms of payment are by Sight Draft. However other terms of payment like establishment of Letter of Credit may be considered by the Purchaser on such terms and conditions as may be agreed upon.	
3.2 The Sight Draft/Letter of Credit will be operative on presentation of the undermentioned documents:	
a) Original Bill of Lading / Airway Bill	
b) Commercially certified invoices describing the stores delivered, quantity, unit rate and their total value in triplicate. The invoice should indicate the discounts, if any and Agency Commission separately	
c) Packing list showing individual dimensions and weight	
d) Country of origin certificate in duplicate	
e) Test Certificate	
f) Declaration by the seller that the contents in each case are not less than those entered in the invoices and the quality of the stores are guaranteed as per the specifications asked for by the Purchaser	
g) Warrantee and Guarantee Certificate vide clause 20.	
4. IMPORT LICENCE:	
Reference to Import License No and date and contract number and date shall be prominently indicated in all the documents vide para 3.2	
5. DEMURRAGE:	
Supplier shall bear demurrage if any incurred by the Purchaser due to delayed presentation of shipping documents as prescribed in para 3.2 to the Bankers within reasonable time(say within 10-12 days) from the date of bill of lading for sea consignments and within 3/4 days from the date of Airway bill for air consignments.	
6. ADDRESS OF INDIAN AGENTS:	

7. GUARANTEED TIME OF DELIVERY:	
The time for and the date of delivery stipulated in the purchase order shall be deemed to be the essence of the contract. Delivery must be completed within the dates specified therein	
8. INSPECTION AND ACCEPTANCE TESTS:	
8.1 The purchaser's representatives shall also be entitled at all reasonable times during manufacture to inspect examine and test on the Contractor's premises the material and workmanship of all stores to be supplied under this Contract and if part of the said Stores is being manufactured on other premises, the Contractor shall obtain for the Purchaser's representative permission to inspect, examine, and test as if the equipment were being manufactured on the Contractor's premises. Such inspection, examination and testing shall not release the contractor from the obligations under this contract.	
8.2 For tests on the premises of the Contractor or of any of his sub-contractors, the contractor shall provide free of cost assistance, labour, materials, electricity, fuel and instruments as may be required or as may be reasonably needed by the Purchaser's representative to carry out the tests efficiently.	
8.3 When the Stores have passed the specified test, the Purchaser's representative shall furnish a certificate to this effect in writing to the Contractor. The Contractor shall provide copies of the test certificates to the Purchaser as may be required.	
9. MODE OF DESPATCH	
Generally stores should be despatched by Indian Flagged Vessel/Air India or through any other Agency nominated by the Purchaser. A copy of the invoice and packing list should be invariably kept inside each of the package.	
10. PORT OF ENTRY: Chennai / Bangalore	
11. PORT CONSIGNEE: } Stores Officer, ISRO Satellite } Centre, Airport Road,	
12. ULTIMATE CONSIGNEE: } Vimanapura Post , } Bangalore,INDIA	
13. SHIPPING MARKS	
The marks on the shipping documents such as invoice, bill of lading and on the packages should be as follows:-	
PURCHASE ORDER NO DATE	
GOVERNMENT OF INDIA	
DEPARTMENT OF SPACE	
ISRO SATELLITE CENTRE	
BANGALORE	

DESTINATION:_____ PORT OF ENTRY_____	
14. INSURANCE OF STORES	
The purchaser shall be responsible for insuring the stores wherever considered necessary. The Contractor shall however be responsible for notifying as per proforma enclosed to the purchaser or the insurers nominated by the purchaser, the complete details of the proposed shipments including the value of each shipment and other relevant data immediately after shipment to enable the purchaser or the insurers to arrange for the issuance of the insurance policy if required. The necessity or otherwise of insurance will be as indicated in the Purchase Order	
15. CONTRACTOR'S DEFAULT LIABILITY	
15.1 The purchaser may upon written notice of default to the Contractor terminate the contract in whole or in part in circumstances detailed hereunder:	
a) If in the judgment of the Purchaser the Contractor fails to make delivery of stores within the time specified in the contract agreement or within the period of which extension has been granted by the Purchaser to the Contractor.	
b) If in the judgment of the Purchaser the contractor fails to comply with any of the other provisions of this contract.	
15.2 In the event of Purchaser terminates the contract in whole or in part as provided in clause 15.1 the Purchaser reserves the right to purchase upon such terms and in a manner as he may deem appropriate stores similar to that terminated and the contractor shall be liable to the purchaser for any additional costs for such similar stores and/or for liquidated damages for delay as defined in clause 19 until such reasonable time as may be required for the final supply of stores.	
15.3 If this contract is terminated as provided in clause 15.1 the purchaser in addition to any other rights provided in this article, may require the contractor to transfer title and deliver to the purchaser under any of the following cases in the manner and as directed by the purchaser.	
a) Any completed stores	
b) Such partially completed stores, drawing information and contract right (herein after called manufacturing material) as the Contractor has specifically produced or acquired for the contract as terminated. The purchaser shall pay to the Contractor the contract price for completed stores delivered to and accepted by the purchaser and for manufacturing materials delivered and accepted.	
15.4 In the event the purchaser does not terminate the	

Contract as provided in clause 15.1 the Contractor, shall continue the performance of the contract, in which case he shall be liable to the purchaser for liquidated damages for delay as set out in clause 19 until the stores are accepted.	
16. REPLACEMENT	
If the Stores or any portion thereof is damaged or lost during transit, the purchaser shall give notice to the contractor setting forth particulars of such stores damaged or lost during transit. The replacement of such stores shall be effected by the contractor within a reasonable time to avoid unnecessary delay in the intended usage of this stores. The price of replacement items shall be paid by the purchaser on the basis of original price quoted in the tender or as reasonably worked out from the tender. The cost of damages will however be claimed by the purchaser from the insurance company. The import License/Customs Clearance permit for the replacement will be provided by the Purchaser.	
17. REJECTION:	
In the event that any of the Stores supplied by the Contractor is found defective in material or workmanship otherwise not in conformity with the requirements of the contract specification, the purchaser shall either reject the stores or request the contractor, in writing to rectify the same. The Contractor on receipt of such notification shall either rectify or replace the defective stores free of cost to the purchaser. If the contractor fails to do so, the purchaser may at his option either.	
a) replace or rectify such defective stores and recover the extra cost so involved from the contractor, or	
b) terminate the contract for default as provided under clause 15 above.	
c) acquire the defective stores at a reduced price considered equitable under the circumstances.	
The provision of this article shall not prejudice the Purchaser's rights under clause 19.	
18. EXTENSION OF TIME:	
If the completion of supply of stores is delayed due to reasons of force majeure such as acts of God, acts of public enemy, acts of Government, fires, floods, epidemic, quarantine, restrictions, strikes and freight embargoes, the Contractor shall give notice within 15 days to the Purchaser in writing of his claim for an extension of time. The purchaser on receipt of such notice after verification, if necessary, may agree to extend the contract delivery date as may be reasonable but without prejudice to other terms and conditions of the contract.	
19. DELAY IN COMPLETION / LIQUIDATED DAMAGES	
If the contractor fails to deliver the Stores within the time specified in the contract or any extension thereof the purchaser shall recover from the contractor as liquidated damages a sum of one-half of one	

percent(0.5 percent) of the contract price of the unde-	
livered stores for each calendar week of delay. The	
total liquidated damages shall not exceed ten percent	
(10 percent) of the contract price of the unit or units	
so delayed. Stores will be deemed to have been delive-	
red only when all its component parts are also deliv-	
ered. If certain components are not delivered in time,	
the Stores will be considered as delayed until such	
time as the missing parts are delivered.	
20. GUARANTEE AND REPLACEMENT	
a) The contractor shall guarantee that the Stores supplied	
comply fully with the specification laid down, for mate	
rial, workmanship and performance.	
b) For a period of twelve months after the acceptance of	
the stores, if any defects are discovered therein or any	
defects therein are found to have developed under proper	
use arising from faulty materials, design or workmanship	
contractor shall remedy such defects at his own cost	
provided he is called upon to do so within a period of	
14 months from the date of acceptance thereof by the	
Purchaser who shall state in writing in what respect the	
stores or any part thereof are faulty.	
c) If in the opinion of the Purchaser it becomes necessary	
to replace or renew any defective stores,such replacement	
or renewal shall be made by the Contractor free of all	
costs to the Purchaser provided the notice informing the	
Contractor of the defect is given by the Purchaser in	
this regard within the said period of 14 months from the	
date of acceptance thereof.	
d) Should the contractor fail to rectify the defects,the pur	
chaser shall have the right to reject or repair or	
replace at the cost of the contractor the whole or any	
portion of the defective stores.	
e) The decision of the Purchaser, notwithstanding any	
prior approval or acceptance or inspection thereof on	
behalf of the Purchaser, as to whether or not the stores	
supplied by the Contractor are defective or any defect	
has developed within the said period of 12 months or as	
to whether the nature of the defects requires renewal or	
replacement shall be final conclusive and binding on the	
contractor.	
f) To fulfil guarantee conditions outlined in clause 20(a)	
to 20(e) above, the contractor shall at the option of	
the purchaser, furnish a bank guarantee)as prescribed	
by the Purchaser-Bank Guarantee enclosed) from a Bank	
approved by the Purchaser for an amount equivalent to	
10% of the value of the contract along with first ship-	
ment documents. On the performance and completion of	
the contract in all respects, the Bank Guarantee will be	
returned to the Contractor without any interest.	
g) All the replacement stores shall be guaranteed for a	
period of of 12 months from the date of arrival of	
Stores at Purchaser's site.	
h) Even while the 12 month guarantee applies to all stores	
in case where a greater period is called for by our	
specifications then such a specification shall apply, in	

such cases the period of 14 months referred to in clause 20(b) and (c) shall be the 'asked for' guarantee period plus two months.	
21. REQUIREMENT OF ADDITIONAL NUMBERS OF STORES/ SPARE PARTS ORDERED	
The contractor shall also undertake the supply of additional number (Nos) of items covered by the order as considered necessary by the Purchaser at a latter date	
The actual price to be paid shall be mutually agreed to after negotiations.	
22 PACKING	
a) The contractor wherever applicable shall pack and crate all stores for sea/air shipment as applicable in a manner suitable for export to a tropical humid climate, in accordance with internationally accepted export practices and in such a manner so as to protect it from damage and deterioration in transit by road, rail or sea for space qualified stores. The contractors shall be held responsible for all damages due to improper packing.	
b) The contractor shall ensure that each box/unit of shipments eligible and properly marked for correct identification. The failure to comply with this requirement shall make the contractor liable for additional expenses involved.	
c) The contractor shall notify the purchaser of the date of shipment from the port of embarkation as well as the expected date of arrival of such shipment at the designated port of arrival.	
d) The contractor shall give complete shipment information concerning the weight, size, content of each packages etc.,	
e) Transshipment of equipment shall not be permitted except with written permission of the Purchaser.	
f) Apart from the dispatch documents negotiated through Bank, the following documents shall also be airmailed to the purchaser within 7 days from the date of shipment by sea and within 3 days in case of air consignments.	
a. Commercial Bill of Lading/Airway Bill/Post parcel Receipt [two non-negotiable copies]	
b. Invoice [3 copies]	
c. Packing list [3 copies]	
d. Test Certificate [3 copies]	
e. Certificate of Origin.	
Contractor shall also ensure that one copy of the packing list is enclosed in each case.	
23. ARBITRATION	

If any time any question, disputes or differences what soever shall arise between the Purchaser and the Contractor upon or in connection with this contract, either party may forthwith give to the other notices in writing of the existence of such question, dispute or difference and the same shall be referred to the adjudication of two arbitrators, one to be nominated by Purchaser, other by a Contractor and in the event of any difference of procedure for arbitration of the international Chamber of Commerce at Paris. The expenses of the arbitrators and umpire shall be paid as may be determined by them. However, the venue of such arbitrators should be in India	
24. LANGUAGE AND MEASURES	
All documents pertaining to the contractor including specification schedule notices, correspondence, Operating and maintenance instructions drawings of any other writings shall be written in English language. The metric system of measurement shall be used exclusively in this contract.	
25. INDEMNITY:	
The contractor shall warrant and be deemed to have warranted that all Stores supplied against this contract are free and clean of infringement of any Patent, copy right or trademark and shall at all times indemnify the Purchaser against all claims which may be made in respect of the Stores for infringement of any right protected by Patent, Registration of design of Trade Mark and shall take all risk of accidents of damage which may cause a failure of the supply from whatever cause arising and the entire responsibility for the sufficiency of all the means used by him for the fulfillment of the contract.	
26. COUNTER TERMS AND CONDITIONS OF SUPPLIERS	
Where counter terms and conditions printed or cyclostyled conditions have been offered by the supplier the same shall not be deemed to have been accepted by the Purchaser, unless specific written acceptance there of is obtained.	
27. SECURITY INTEREST:	
On each item to be delivered under this contract, including an item of work in progress in respect of which payments have been made in accordance with the terms of the contract, Purchaser shall have a security interest in such items which shall be deemed to be released only at the time when the applicable deliverable item is finally accepted and delivered to the Purchaser in accordance with the terms of the contract. Such security interest of the Purchaser shall constitute a prior charge as against any other charge of interest created in respect of such items by any other entity.	
28. BANK CHARGES	
While the Purchaser shall bear the bank charges payable to his Banker (State Bank of India, ISRO Branch, Airport Raod, Vimanapura, Bangalore - 560 017) the Contractor	

shall bear the Bank Charges payable to his Bankers	
including the Charges towards advising amendment commis-	
sions.	
29. TRAINING:	
The Contractor shall, if required by the Purchaser,	
provide facilities for the practical training of Pur-	
chaser's engineering or technical personnel from India	
and for their active association on the manufacturing	
process throughout the manufacturing period of the	
contract/stores, number of such personnel to be mutually	
agreed upon.	
30. APPLICABLE LAW:	
The Contract shall be interpreted, construed and gov-	
erned by the laws of India.	
31. ANY OTHER POINTS	
	SIGNATURE OF THE PARTY _____
	NAME _____
	COMPANY _____
	SEAL _____
	DATE _____

ISRO SATELLITE CENTRE

**SPECIAL INSTRUCTIONS WITH REGARD TO SERVICE CONTRACTS FOR OUT
SOURCING**

Tenderers should read the following instructions carefully and indicate compliance/non-compliance in their quotation for each point/requirement. In case the quotation received from any tenderer is silent on any point/requirement, ISRO/ISAC reserves the right to ignore such quotation without any further reference to the tenderer.

1. Scope of the Service Contract:

The Scope of Service contract is as per Annexure I.

2. Period of the Service Contract:

The Service Contract shall be valid for a period of mentioned in Appendix-I from the date of issue of the Order or from the date of submission of the Police Verification Report of the work force, whichever is later. However, performance of the Service Provider will be reviewed after a period of 3 months from the date of commencement of the Contract by ISRO/ISAC. If found satisfactory, contract will be continued for the remaining period.

2.2 The Service Contract can be extended by another one year consent.

2.3 Each Party shall have the right to terminate the Contract at any time during the currency of the Contract by giving one month's notice to the other Party.

3. License under Central/State Labour Acts/Rules:

ISRO/ISAC will issue necessary certificate in **Form V** to the successful Tenderer for obtaining the necessary license from the appropriate Labour authorities under the various Central/State Labour Acts/Rules for deployment of the work force for executing the tendered Service. The Contractor should submit a certified copy of such a license within one month from the date of commencement of the Service Contract, failing which the Service Contract will be terminated by ISRO/ISAC without any further notice.

4. Registration under the Employees' Provident Funds & Miscellaneous Provisions Act/Rules:

4.1 The Tenderer should mention the Registration No. under the Employees' Provident Funds Act & Miscellaneous Provisions Act/Rules. The Tenderer should furnish a copy of the EPF Registration Certificate along with the tender.

4.2 The Employer's contribution towards EPF will be reimbursed by ISRO/ISAC to the Contractor on showing proof of payment made to the Provident Fund Authorities. Such reimbursement claim submitted by the Contractor should indicate the details of the work force, their EPF A/C No., their contribution, Employer's contribution sought to be reimbursed, etc., and the EPF Challan amount should tally with the contract wise details as above. The EPF Passbook and the Annual PF Statement should be submitted for verification. If & when called for.

5. PRICES:

Being a Service Contract, the rates should be quoted **with break up strictly complying with the Minimum Wages Act and with the Work Quantification.** The break up shall indicate the Minimum Wages payable per day/month (including D.A.), EPF, ESI, Service Tax etc. (Proforma as per Appendix-I).

5.2 The Minimum Wages (including D.A.) payable per day/month for the various Categories is mentioned in Appendix-I.

5.3 In case of any revision of minimum service charges during the currency of the Contract, the service charges payable to such work force would be revised to the

Level fixed from that date. There will, however, be no change in the Service charge / Profit margin payable to the Service Provider on account of such revision.

6 Employee's Provident fund & ESI / Medical Facility.

6.1. The prescribed employer's contribution under the Employee's Provident Fund and

Miscellaneous Act, 1952, shall be reimbursed by ISRO/ISAC to the Service Provider

On showing proof of its payment to individual account each month.

6.2 For such of the workforce deployed by the Service Provider whose total wage is **below Rs.10,000/- p.m.** the ESI Act, 1948 will apply. The rate of contribution is

6.5% of which 1.75% shall be borne by the workforce concerned and 4.75% shall

be reimbursed by ISRO/ISAC to the Service Provider as employer's contribution on showing proof of its payment towards each individual for each month.

6.3 For such the workforce deployed by the Service Providers whose total wage is **above Rs.10,000/-p.m.,** the ESI Act, 1948 is not applicable. Such work

force shall be covered by a **Mediclaim Policy** from a **Nationalised Insurance Company** with a coverage of **Rs.2,00,000/- per annum.** The payment of

the Monthly premium shall be shared by ISRO/ISAC and the workforce in the ratio of

73.08% & 26.92% respectively (rounded off to the nearest rupee). The Employers Contribution towards premium amount shall be reimbursed to the Service Provider on showing proof of payment of the total premium each month.

6.4 Any failure on the part of the Service Provider in compliance of above facilities would result in cancellation of Work Order or termination of the Contract forthwith.

7. Service Tax and other Statutory levies:

ISRO/ISAC shall reimburse the Service Tax and other statutory levies paid by the Contractor, against proof of payment.

8. Skill level required for executing the Service Contract:

ISRO/ISAC has fixed the following skill level as mentioned in Appendix-I for the work force of the Contractor for executing the Service Contract.

9. Police verification of the character and antecedents of the work force:

9.1 The Contractor would be required to provide verification report from the local Police authorities within one month from the date of receipt of the Letter of Intent, duly certifying the verification of Character & Antecedents for each of the work force engaged by the Contractor for executing the service contract in ISRO/ISAC. For this purpose, if required, ISRO/ISAC will issue a letter to the concerned Police authority certifying the award of the Service Contract to the Contractor, which can be used by the Contractor for expediting the Police verification.

9.2 The Contractor should also verify/certify the conduct of the work force at frequent intervals. If any of the work force misbehaves or commits any misconduct, ISRO/ISAC reserves the right to refuse permission to such persons to enter its premises, and such work force shall be withdrawn by the Contractor immediately.

10. Non-Disclosure Agreement:

The work force engaged by the Contractor for executing the Service Contract in ISRO/ISAC should sign a Non-Disclosure Agreement. It shall be the Contractor's responsibility to get the signature of their work force on the Non-Disclosure Agreement and submit the same to the ISRO/ISAC. Any violation in this regard will result in the termination of the Contract without any notice.

11. Wage disbursement:

The tenderer should indicate the mode of wage disbursement to the work force. ISRO/ISAC generally insists on payment to the work force by cheque. The payment of wages to the work force should be made in the presence of Principal Employer or his representative and in our premises on or before 7th of each month. The documentary proof of payment of wages to the work force/acquittance should invariably be furnished by the Contractor.

12. Identity Card:

The work force of the Contractor should be issued with the Company ID Card, a sample copy of which should be furnished to the ISRO/ISAC. In case, ISRO/ISAC issues any Access Control System ID card to the work force, the expenditure for the same should be borne by the Contractor.

13. Submission of claims/bills and their settlement:

12.1 The Contractor should submit his bills by the 5th of the succeeding month to the Contract Manager identified by ISRO/ISAC, along with the following:

(a) Proof of payment of the Fixed Monthly Compensation to the work force for the preceding month.

(b) Proof of payment of the Employer's share of EPF, for the preceding month, along with a statement showing the details of all the work force, their EPF Account, their contribution, Employer's contribution sought to be reimbursed, etc. The EPF Challan amount should tally with the contract-wise details as above.

- (c) Proof of payment of the Employer's share of the ESI contribution for the preceding month, along with a statement showing the details of the work force engaged by the Contractor for the particular contract, their Insurance number, their contribution, Employer's contribution sought to be reimbursed, etc. The ESI Challan amount should tally with the amount sought to be reimbursed.
- (d) In case of any work force not eligible for coverage under the ESI Act/Rules, proof of payment of Employer's share of the premium for the preceding month for the Medi-claim policy along with a statement showing the policy details, etc. shall be produced for reimbursement. Employer's share of premium shall be limited to rates prescribed for ESI i.e., 4.75%.
- (e) Proof of remittance of the Service Tax for the preceding month to the Service Tax authorities.

13.2 After necessary certification by the Contract Manager, duly approved by the General Manager or Group Director or Deputy Director or the Division Head, as the case may be, the admissible payment will be released by the Accounts Division within 10 (ten) days from the date of receipt of the bill from the Contractor.

14. Security Deposit/Bank Guarantee:

The Security Deposit payable by the Contractor shall be 7.5% of the value of the service contract, and the same shall be recovered in equal installments in the running bills or else the Contractor may furnish a Bank Guarantee for 7.5% of the value of the service contract. The Security Deposit will be released or the Bank Guarantee returned after the Contractor fulfills all the contractual obligations.

15. Parallel contracts:

ISRO/ISAC reserves the right to enter into parallel contract(s) for the same service with one or more other contractors during the currency of the contract.

16. General:

16.1 The pattern of working followed by ISRO/ISAC is as under:

- (a) Normal working hours are from 8.30 am to 5.00 pm with 30 minutes lunch break.
- (b) Normal Working days are from Monday through Saturday.
- (c) However, in case of exigencies of work, the persons deployed should be ready to work beyond office hours and on holidays as per the requirement of the concerned Project/Division/Section Heads.

16.2 The contract work force should make their own transport arrangement for executing the service contract, and ISRO/ISAC will have no liability for the same.

16.3 The contract work force will not be entitled for the subsidized canteen facilities of ISRO/ISAC, but can use only the Food Court functioning in the campus.

16.4 The certification relating to the skill level of the contract work force should be submitted to the ISRO/ISAC Contract Manager, who reserves the right to identify the work force for executing the contracted service.

16.5 The Contractor should indicate the telephone & fax numbers (both official and residential) of the CEO of the company/establishment for communication purpose.

16.6 If any damage is caused to ISRO/ISAC property by any work force of the Contractor or if they sustain any injury due to their negligence, the responsibility for the same shall solely rest with the Contractor, and an Indemnity Bond to this effect should be executed by the Contractor.

• * *

SPECIAL INSTRUCTIONS TO SERVICE PROVIDER:

QUOTATION SHOULD BE SUBMITTED FOR NUMBER OF UNIT/MAN HOURS OF WORK QUANTIFICATION AS MENTIONED IN THE ANNEXURE. THE MINIMUM WAGES AS INDICATED IN THE TABLE (SL.NO.03) OF APPENDIX-I SHALL BE TAKEN INTO CONSIDERATION WHILE COMPUTING THE RATE FOR QUANTIFICATION.

“QUOTATION RECEIVED WITHOUT ADHERENCE TO THE ABOVE STIPULATION WILL NOT BE CONSIDERED”

* * *

SL. NO. 01

FILE NO. ISGE2010018948

ITEM DESCRIPTION: ALUMINIUM ALLOY PLATE
(AL 6061 T651)

Description : Finishing Aluminium plate (Rolled/Forged).

Material grade : Aluminium Alloy – AL 6061 T651.

Standards : To be specified by the bidder/supplier.
(AMS-QQ-A/-250/11)
ASTM B 209

Quantity : As given in Table-1.

Table-1

SL. NO.	Block / Plate size	No. of Plate
1.	600 mm*600 mm*114.3 mm	19
2.	700 mm*500 mm*65 mm	11
3.	700 mm*700 mm*152.4 mm	03
4.	1220 mm*1220 mm*38.1 mm	12
5.	600 mm*600 mm*101.6 mm	02
6.	2440 mm*1220 mm*12.70 mm	03
7.	2440 mm*1220 mm*19.05 mm	03
8.	2440 mm*1220 mm*25.40 mm	03

Testings

- a) Material test : i) Mechanical test for the mechanical properties. **
ii) Chemical test for chemical composition.
- b) Ultrasonic testing : 100% Ultrasonic testing for all plates.

Note: 1) Number of samples and size of sample for material testing shall be provide by the bidder.
ii) Sample charge for testing and testing charges shall be quoted separately.

**

UTS, PROOF, YTS, %ELONGATION, HARDNES ETC.,

UTS → ULTIMATE TENSILE STRENGTH

TTS → YIELD TENSILE STRENGTH

TERMS & CONDITIONS

I) TPI (Third Party Inspection) agency : The supplier shall employ TPI agency like Lloyds, BV (BEMORE THE VERITES) etc. (ISRO AUTHORISED AGENCIES)
The charges of TPI agency shall be quoted separately.

II) Scope of TPI agency : a) Visual and dimensional inspection.

b) Identification of sample material for material testing.

c) Review and approval (Signature with stamped) of material tests' (Mechanical & Chemical tests) certificates.

d) Witnessing of 100% ultrasonic testing & inspection of all plates.

e) Approval (Signature with stamped) of ultrasonic test certificates for all plates.

f) All inspected plates shall be stamped by TPI agency

III) Dispatch of item : The supplier shall provide the following documents before dispatching the items

a) Material tests' (Mechanical & Chemical) certificates duly approved (signed & stamped) by TPI agency.

b) Ultrasonic test certificates duly approved (signed & stamped) by TPI agency.

c) Inspection release note for dispatching the items.

After receiving the above documents, the documents will be reviewed by us. Only after satisfactory review & verification, we will provide the "dispatch clearance" to the supplier for dispatching the items. The supplier shall supply the items only after receiving "dispatch clearance" note from us.

IV) Marking & Packing : Marking of each plate and Packing of plates for dispatch, shall be done as per the relevant standard.

V) Payment : Only after receipt and acceptance of the items at out end.

SL. NO. 02

FILE NO. ISIR2010019007

ITEM DESCRIPTION : HIGH SPEED DIFFERENTIAL LINE DRIVER
AND RECEIVER

SL. NO	COMPONENT TYPE AND OR TECHNICALLY SUITABLE EQUIVALENTS	QUANTITY REQUIRED IN SLABS
01	DS90C031 OR UT54LVDS031 OPERATING VOLTAGE : 5 V	100*, 150*, 200*, 250*
02	DS90C032 OR UT54LVDS032 OPERATING VOLTAGE : 5V	100*, 150*, 200*, 250*
03	DS90LV031 OR UT54LVDS031LV OR SN55LVDS 31-SP OR RH-LVDS31K OPERATING VOLTAGE : 3.3V	100*, 150*, 200*, 250*
04	DS90LV032 OR UT54LVDS032LV OR SN55LVDS32/33-SP OR RH-LVDS 32 K OPERATING VOLTAGE : 3.3V	100*, 150*, 200*, 250*

NOTE: PACKAGE STYLE: 16 PIN CERAMIC FLAT PACKS
QUOTE FOR ABOVE SPACE GRADE PARTS OF
TECHNICALLY SUITABLE EQUIVALENTS RESPECTIVELY
AS PER THE SPEC. FOR 5 VOLTS AND 3.3.
VOLTS SEPERATELY.

A. DEVICE DETAILS

The Devices shall be of the part numbers as per the list or form fit functional equivalent in 16 pin ceramic flatpack. The receiver and driver should be from same manufacturer.

A. DEVICE QUALITY

1. The devices shall be qualified to the QML'V' quality level of MIL-PRF-38535.
2. All the devices shall undergo Pre-cap visual examination on 100% as per of MIL-PRF-38535 QML 'V'. **ISRO reserves right to participate during precap visual inspection or nominate 3rd party for performing Precap Visual inspection.** Quote separately the cost for performing precap by 3rd party. Address and details of the 3rd party to be provided along with the quote.
3. All parts shall be serialized & screened as per QML 'V' of MIL-PRF-38535.

4. The devices shall meet TID requirements of 50Krad (Si) minimum, Single Event Latch Up LET of minimum 80 MeV/mg/cm² and Single Event Upset LET of minimum 40 MeV/mg/cm². Please quote for TID of 100Krad (Si) also.
5. The devices shall undergo Group A tests on 100% of the lot.
6. One sample drawn from the deliverable quantities of each device type shall undergo Destructive Physical Analysis (DPA) as per the MIL-STD-883 Test Method 5009 (Quote optionally).
7. One / three samples from the deliverable quantities of each device type shall undergo life test. (Quote optionally).

B. DATAPACK REQUIREMENTS

The following Data shall accompany the devices in soft copy (compact disk):

1. Certificate of Conformance issued by the manufacturer and the supplier.
Manufacturer's Precap Visual Inspection report as applicable.
Screening results by attributes and variables and Group A test data.
TCI Generic data for the quarter during which these devices are processed.
Radiation Test report.
Life test data with samples if ordered.
DPA test report with samples if ordered.

C. OTHER REQUIREMENTS

1. Each device type shall be supplied from lots with same date code. The devices shall be drawn from lots manufactured within 2 years of the date of shipment. Supply of devices from lots older than 2 years from the date of shipment shall be indicated in the quotation and will require approval of ISAC before shipment.
2. Devices shall be packed in ESD safe packs, optionally quote for individual vacuum packing.
3. The devices shall have gold-coated leads and the device body and/or leads shall NOT have any black/ brown/ red spots.
4. Only Vendors/Suppliers authorized to source above Space Grade components from the Manufacturer will be considered. Necessary authorization Certificate from the Manufacturer shall be enclosed along with the offer.

D. RESPONSIBILITIES OF THE SUPPLIER

The supplier will undertake following additional tasks to ensure that the devices meet the necessary quality requirements:

1. **Monitor manufacturer wherever and perform Final Customer Source Inspection (FCSI). ISRO reserves rights to participate during FCSI or nominate qualified agency to perform FCSI.** Quote separately the cost for performing FCSI by 3rd party. Address and details of the 3rd party to be provide along with the quote.
2. Perform 100% Incoming Inspection & Data Package review before shipment.
3. Report to ISAC all NCR/DCN (Document Change Notice) during procurement/testing.

Please provide the point-by-point compliance to specification in your quote.

Quote separately for operating voltage of +5V and +3.3V.

SL. NO. 03

FILE NO. ISCO2010019020

DESCRIPTION: TECHNICAL SUPPORT SERVICES

Annexure-1

1. Scope of Work:

1. Architects for planning (2 Nos)

Architects are required to understand the users' requirements for any proposed new project and prepare necessary line sketches broadly indicating the facility requirements like, the size of rooms/labs, facilities, along with functional heights etc., Broad outlay of specifications to suite the users requirements also need to be specified in the line sketches. Once the works are cleared by GCWRC, detailed planning need to be taken up to prepare the preliminary architectural drawings indicating all the relevant information through plans sections/elevations and also 3D views wherever required. All detailed specifications also need to be incorporated to prepare the realistic estimates. Once the estimates are approved by the competent authority, working architectural drawings need to be prepared for the purpose of construction including necessary site co-ordination, etc., Subsequent to the execution of the work at the site, completion drawings also need to be prepared as per the actual details as built. Besides all these activities, Architects need to be involved in day to day co-ordination with the site Engineers as well as Design Engineers to ensure smooth progress of the work.

REQUIREMENTS:

Candidates should have passed B.Arch. obtaining I class from a reputed institution and have experience in planning of buildings such as Technical facilities, Laboratories, Office accommodation including workshops and highbays. The knowledge in planning of clean rooms, R & D Centres is preferable. Candidates should have knowledge of Autocad. Autodesk including 3D Max and Revit softwares. Candidate shall have registration with India Council of Architecture.

No. of Drawings per month / per architect = 2 Nos.
For two architects = 2 x 2 = 4 Nos.
For One year = 4 x 12 Nos. 48 drgs.

2. Site	Quantity	Unit cost including Service Tax [Each]	Engineers (2 Nos)
	48 Drgs.		

They have to study and understand all the architectural / structural details along with service drawings and ensure the work is preceded without any hindrance. Actual site

conditions are to be considered while executing the job and necessary modified details , suggestions are to be obtained from Architects / Design Engineers, so that construction work is carried out. Further, they have to monitor the progress of the work as per the targeted schedules, so that allotted budget is spent for the work. They also need to **assist EIC in measuring the works**, so that regular RA Bills can be prepared. Also, they are required to be involved in ensuring the quality and safety at the site.

Providing a working mechanism for over all control of construction activities with two Nos. of supervisors having Diploma in Civil Engineering

Qualification with minimum three years experience in supervision of Civil Engineering works and to assist the Department Engineers for:

- a. Supervision of total construction works at ISAC and ISITE Campuses or any other work undertaken by C & MG.
- b. Preparation of estimates.
- c. Maintenance of records and other related works as assigned by Department Engineers. Supervisors shall also have working computer knowledge for:

REQUIREMENTS:

Candidates should have passed Diploma in Civil Engineering from reputed Institutions obtaining 1st class and should have experience in construction industry for minimum of 01 to 02 years. Should have knowledge in preparation of estimates for technical and industrial building. He should work independently in construction site. Also should have knowledge in chain / plane table and tachometry surveying and usage of computers.

Quantity	Unit cost including Service Tax [Each]
12 Jobs	

3. Structural Draughtsman (1 No.)

Draughtsman has to prepare structural drawings based on the architectural drawings and the basic design details provided by the structural engineer by using the softwares like AutoCAD / REVIT etc.,

The drawing work involves preparation of foundation drawings / details of columns / footings pedestals tie beam details / floor slabs & beams / roof slab and L-sections of the beams along with staircase / water tank details etc., This involves thorough understanding of design requirements so that preliminary sketches can be prepared for the purpose of estimation / tendering and working structural drawings for the purpose of execution. Draughtsman also need to co-ordinate with architects / design engineers to obtain the required design details.

REQUIREMENTS:

Candidates should have passed Diploma in Civil Engineering from reputed Institutions obtaining 1st class and should have experience of 01 to 02 years in draughting of structural drawings especially in concrete structures. He should possess knowledge of Auto Cad Rivet softwares. He should be independently able to prepare structural drawings referring to structural sketches furnished by structural engineers.

No. of drawings : 2 Nos. per month
 For One year : 1 x 12 x 2 = 24 drawings.
 The above no. of drawings are indicated in schedule.

Quantity	Unit cost including Service Tax [Each]
24 Drgs	

4. Electrical Draughtsman (1 No.) :

The Draughtsman job involves incorporation of electrical scheme, power point layout, indication LDB/PDBs, MV panel cable routing indication of special earthing system, lighting protection system, system earthing with all necessary legends and notes and also to prepare tender drawings, construction drawings, electric single line schematic drawings, electric single line schematic drawings including revising of drawings as and when required, preparation of sub-station layouts, street lighting, area lighting, transformer yards, transformer / DG, set layouts with foundation for transformer / DG sets, cable trenches. Also, including preparation of detailed drawings of installation of fittings, street light panels, ceilings etc. for installation details, drawings of control circuits conduits conduit layouts for internal electrification works. All the above jobs have to be done using AutoCAD software getting hard copies of drawings complete as directed by Engineer-in-charge (Electrical).

REQUIREMENTS:

Candidates should have passed Diploma in Electrical Engineering from reputed Institutions obtaining 1st class and should have experience of 01 to 02 years in draughting of electrical conduit and layout drawings especially in buildings. He should possess knowledge of Auto Cad / Rivet softwares. He should be independently able to prepare electrical drawings referring to architectural drawings and able to form electrical schemes and sketches furnished by electrical engineers.

No. of drawings per month : 2 Nos.
 For One year : 1 x 12 x 2 = 24 drawings.

Quantity	Unit cost including Service Tax [Each]
24 Drgs	

APPENDIX-1 to FM018

- PERIOD OF SERVICE CONTRACT:** ONE YEAR
- Skill level required for executing the Service Contract:**

Sl. No.	No. of work force for executing the Service Contract	Skill level required for executing the Service Contract (qualification, experience, etc.)
1.	02 NOS.	ARCHITECTS ,
2.	02 NOS. 01 NO. 01 NO	SITE ENGINEERS STRUCTURAL D'MAN ELECTRICAL D'MAN

3. The Minimum Service Charges (including D.A.) payable per day/month for the various categories

Sl. No.	Category & Competency / Skill-level required	Service Charge payable per day (8 hrs)	Service Charges payable for a month (in case of 26 Working days)
1.	Technical Personnel (Diploma) / Diploma level Site Engineers / Electrical & Structural Draughtsman.	Rs.440/-	Rs.13,200/-
2.	Technical Personnel (BE, (Architects)	Rs.733.33	Rs.22,000/-

SL. NO. 04**FILE NO. ISIR 2010019090****ITEM DESCRIPTION : SPACE GRADE BAND PASS
FILTERS****QUANTITIES:**

SL. NO.	CENTER FREQUENCY	QUANTITIES
01	199.58 MHz BPf	QUOTE IN SLABS OF 10 ⁺ , 20 ⁺ , 25 ⁺
02	10.7 MHz BPf	QUOTE IN SLABS OF 10 ⁺ , 20 ⁺ , 25 ⁺
03	121.5MHz BPf	QUOTE IN SLABS OF 10 ⁺ , 20 ⁺ , 25 ⁺
04	441.64 MHz BPf	QUOTE IN SLABS OF 10 ⁺ , 20 ⁺ , 25 ⁺

The Filters as a minimum shall meet the following requirements.

A. ELECTRICAL SPECIFICATION:

- Center Frequency (Fo) : 199.58MHz**
3 dB Bandwidth : 5MHz min
Insertion loss : 12dB(max) at Fo
Pass band return loss : 14dB at Fo In/Out
30dBc Bandwidth : 15MHz Max
Input power : 0.5 Watts max
Impedance : 50 Ω
Operating temperature range : -30°C to +60°C
Package Size : Miniature PCB mountable (as per attached Figure 1)
- Center Frequency (Fo) : 10.7 MHz**
3 dB Bandwidth : 750 KHz min
Insertion loss : 12dB(max) at Fo
Pass band return loss : 13dB at Fo In/Out
40dBc Bandwidth : 1.5MHz max

Input power : 0.5 Watts max
Impedance : 50 Ω
Operating temperature range : -30°C to +60°C
Package Size : Miniature PCB mountable (as per figure 1)

3. **Center Frequency (Fo)** : 121.5 MHz
3 dB Bandwidth : 6MHz min
Insertion loss : 6dB(max) at Fo
Pass band return loss : 15dB min at Fo In/Out
30dBc Bandwidth : 15MHz max
Input power : 0.5 Watts max
Impedance : 50 Ω
Operating temperature range : -30°C to +60°C
Package Size : Miniature PCB mountable (as per figure 1)

4. **Center Frequency (Fo)** : 441.64 MHz
3 dB Bandwidth : 15 MHz min
Insertion loss : 5dB(max) at Fo
Pass band return loss : 15dB at Fo In/Out
30dBc Bandwidth : ± 60 MHz max
Rejection from 520MHz to 800MHz : 40dBc min
Input power : 0.5 Watts max
Impedance : 50 Ω
Operating temperature range : -30°C to +60°C
Package Size : Miniature PCB mountable (as per figure 1)
or
smaller

Note : All pin assignments (Input, Output and GNDs) should be marked on the top of the package.

B. QUALITY REQUIREMENTS:

Filter shall be Designed, constructed and tested based on MIL-F-18327F, to meet all the above electrical specifications.

Passive elements used in the fabrication shall be ER Series of MIL with failure rate level 'R' or better OR processed to standard manufacturers internal H1-rel flow with element evaluation to Class 'K' of MIL-PRF-38534G.

The package evaluation shall be performed as per Table C-VI of MIL-PRF-38534G.

The materials used in the fabrication should be capable of meeting the Outgassing specifications as per ASTM E595 with TML<1% & CVCM <0.1%.

All the devices shall be serialized and subjected to the following screening tests. (The test method & condition shall be as per MIL-F-18327F)

External visual and Mechanical inspection

Baking at max. rated temperature for 48 Hrs

Temperature Cycling at extreme temperature

Burn-in at rated voltage for 240Hrs @ rated temperature

Seal

Electrical testing @ ambient and temperature extremes including the following

- a. Dielectric withstanding voltage
- b. Insulation resistance
- c. Electrical characteristics (As per specification)

Eight samples randomly drawn from the deliverable screened lot shall be subjected to First article inspection (Table VI) of MIL-F-18327F.

(Quote separately for Group I, II & III.)

C. DATA PACK REQUIREMENTS:

Following test data shall be supplied along with the filters

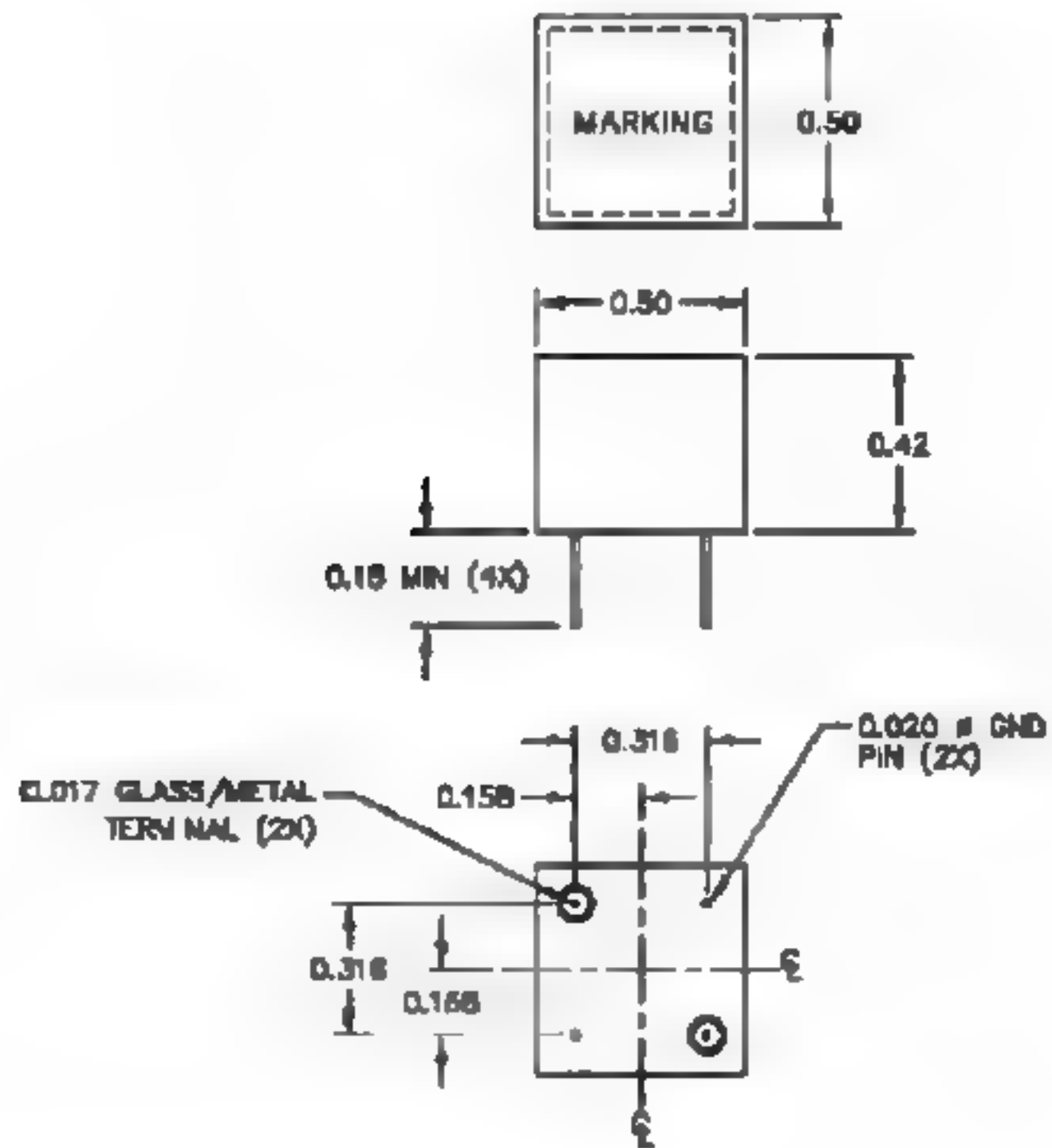
1. Certificate of conformance from the manufacturer & Supplier.
2. Summary sheet of Screening & First article inspection test giving details of tests performed, test conditions, date of test, no. of devices tested/passed, etc.
3. 100% Variable data of screening tests and First article inspection test.
4. Life test & Internal visual report

D. OTHER REQUIREMENTS:

1. All the devices of each line item shall be from the same lot date code and not older than one year w.r.t the date of shipment.
2. Provide the electrical and mechanical data sheet of the parts along with the quote.
3. Mention the name of the manufacturer in the quote.
4. Supplier shall submit a letter from manufacturer, stating that they are authorized to supply the product offered.
5. Supplier shall have heritage of supplying the MIL/Space grade components. Proof of the same shall be submitted along with the quotation.
6. Mention the availability of generic test data of Group tests. Also mention if this data can be shared. If yes, indicate the date of testing.

Please provide point-by-point compliance to the above requirements/Electrical Specifications in your quote. Otherwise the offer may not be considered.

FIGURE-1 DIMENSIONAL DRAWING



Note: All dimensions are in inches.

ANNEXURE - 1

TABLE VI. First article inspection

Inspection	Grades		Requirement paragraph	Test paragraph	Number of sample units to be inspected
	4, 6 8	5, 7 9			
<u>Group I</u>					
Visual and mechanical inspection (external) <u>1/</u> -----	X	X	3.1, 3.3, 3.4 to 3.4.3 incl., 3.4.5, 3.25, and 3.26	4.7.1.1	10
Terminal strength <u>2/</u> -----	X	X	3.5	4.7.2	
Solderability (when specified) -----	X	X	3.6	4.7.3	
Resistance to soldering heat (when specified) -----	X	X	3.7	4.7.4	
Seal -----	X	X	3.8	4.7.5	
Dielectric withstanding voltage -----	X	X	3.9	4.7.6	
Insulation resistance -----	X	X	3.10	4.7.7	
Electrical characteristics -----	X	X	3.11	4.7.8	
Stability at temperature extremes -----	X	X	3.12	4.7.9	
<u>Group II</u>					
Life (at elevated ambient temperature) - -	X	X	3.13	4.7.10	2
<u>Group III</u>					
Temperature use (when specified) <u>1/ 3/</u>	X	X	3.14	4.7.11	6
Vibration -----	X	X	3.15	4.7.12	
Shock -----	X	X	3.16	4.7.13	
Thermal shock -----	X	X	3.17	4.7.14	
Immersion -----	X	X	3.18	4.7.15	
Moisture resistance <u>4/</u> -----	X	X	3.19	4.7.16	

See footnotes at end of table.

TABLE VI. First article inspection - Continued.

Inspection	Grades		Requirement paragraph	Test paragraph	Number of sample units to be inspected
	4, 6 8	5, 7 9			
Group III - Continued					
Salt atmosphere(when specified) <u>4/</u>	X	X	3.20	4.7.17	6
Acceleration (when specified)-----	X	X	3.21	4.7.18	
Electrical characteristics -----	X	X	3.11	4.7.8	
Visual and mechanical inspection (external) <u>1/</u> -----	X	X	3.1, 3.3, 3.4 to 3.4.3 incl, 3.4.5, 3.25 and 3.26	4.7.1.1	
Resistance to solvents -----	X	X	3.23	4.7.20	3
Flammability (external flame) (grades 5, 7, and 9 only) -----	—	X	3.24	4.7.19	
Visual and mechanical inspection (internal) -----	X	X	3.1, 3.3, 3.3.2, 3.4.4, and 3.26	4.7.1.2	
Group IV					
Fungus <u>5/</u> -----	X	X	3.24	4.7.21	2

1/ Nondestructive tests

2/ For grades 4, 6, and 8 the torque test is applicable only to terminals with screw threads

3/ Two sample units only.

4/ When salt atmosphere is specified, the six sample units shall be divided into two equal groups. Each group shall be inspected, independently for moisture resistance and salt atmosphere. When these examinations are performed in the foregoing manner, separate test data shall be submitted for each group.

5/ Test shall not be performed if the manufacturer provides certification that all external materials are fungus resistant.

SL. NO. 05

FILE NO. ISDD0 2010019094

**DESCRIPTION: MANNING OF FITTING, TURNING, MILLING, PART
DRAWING WORK.**

1. Scope of work by the Contractor:

The Contractor has to carry out Fitting, part drawing preparation, Milling & Turning of Pre-machining jobs at General Fabrication Facility and at Precision Fabrication Facility from 8.30 a.m. to 5.00 p.m. from Monday to Saturday and under exigencies the work needs to be carried out till 9.30 p.m. and even on Sunday also.

2. Scope of the Department:

The incumbent Contractor will be issued with raw material, tools, measuring instruments, Required machines like drilling milling and lathes, component drawings and computer system for creation of the above mentioned jobs.

3. Quantity:

Sl.No	Nature of work	Total No. Of Units	No. of Persons	Qualification & Experience required.
3.1	Part drawing work	650	1	Diploma in Mechanical Engineering with experience in AutoCAD.
3.2	Fitting work	5,000	2	ITI Fitter (with one year experience)
3.3	Milling work	10,000	4	ITI Machinist (with one year experience)
3.4	Turning work	5,000	2	ITI Turner (with one year experience)
3.5	Technical helper	5,000	2	SSLC Passed

For sl.no.3.1 one unit of work= Making of drawing in Two A4 size sheet.

For sl.no.3.2 to 3.5 one unit of work = Two man hours.

4.0 Specification:

For carrying out works at Sl.No.3.1 Diploma in Mechanical Engineering with experience in Auto CAD is necessary. Experience in reading and understanding the component drawings and mechanical process planning is essential. Preparation of part drawing work to be carried out on PC using AUTOCAD supplied by ISAC.

For carrying out works at Sl.No. 3.2 Knowledge of fitting at ITI level with one year experience is necessary. Experience in reading and understanding the component drawings and usage of measuring instruments is also essential. Fitting operations like Filing, Drilling, Tapping and Deburring to be carried out on different materials like Aluminum alloys, Magnesium alloys, MS, SS and Titanium alloys with the help of standard fitting tools supplied by ISAC.

For carrying out works at Sl.No. 3.3 Knowledge of milling at ITI level with one year experience is necessary. Experience in operating different types milling machines, reading and understanding the component drawings and usage of measuring instruments is also essential. Milling operations like Face Milling, Side Milling, Taper Milling, Pocketing, Boring and Reaming are to be carried out on different materials like Aluminum alloys, Magnesium alloys, MS, SS and Titanium alloys with the help of HSS and solid carbide cutting tools. All the milling operations are to be carried out on HMT(FN2V, 3V and M1TR) and BFW(FU1.5 & FU2) milling machines supplied by ISAC.

For carrying out works at Sl.No. 3.4 Knowledge of turning at ITI level with one year experience is necessary. Experience in operating different types of lathes, reading and understanding the component drawings and usage of measuring instruments is also essential. Turning operations like Plain turning, step turning, taper turning, internal and External thread like Aluminum alloys, Magnesium alloys, MS, SS and Titanium alloys with the help of HSS and solid carbide cutting tools. All the turning operations are to be carried out on HMT(LB17 & LB20) and Geedee Weiler lathes supplied by ISAC.

For carrying out works at Sl.No.3.5 SSLC with one year experience on shop floor as helper & he should know about general industrial safety. The works involves Cleaning of chips on machines & cleaning of shop floor, Topping up of coolant & hydraulic oil for machines available at GFF & PFF, Applying &

removing of lacquer on magnesium components, Moving of material & files with in ISAC.

5.0 Period of Contract:

Period of contract is two year and extendable for one more year.

6.0 Continuity of work is assured for a period of two year presently. This may be extended by another one year.

7.0 Quotes to be given on per unit basis irrespective of when the work was carried out (working day or Holiday) and quotes in any other form will be rejected. However, works need to be done on daytime.

8.0 It is necessary that all personnel deployed should be provided with Uniform with company logo and proof. Proof of payment of PF and ESI should be shown to Contract Manager. Also the photocopy of the company's ID issued to all personnel should be made available to Contract Manager. Proof regarding payment of salary to all personnel shall be made available to Contract Manager every month.

APPENDIX-1 to FM018

01. PERIOD OF SERVICE CONTRACT: TWO YEARS

02. Skill level required for executing the Service Contract:

Sl. No.	No. of work force for executing the Service Contract	Skill level required for executing the Service Contract (qualification, experience, etc.)
1.	01 NO.	Diploma In Mechanical Engineering with experience in AutoCAD
2.	02 NOS. 04 NOS 02 NOS	ITI Fitter (with one year experience) ITI Machinist (with one year experience) ITI Turner (with one year experience)
3.	02 NOS	SSLC Passed (Technical Helper)

3. The Minimum Service Charges (including D.A.) payable per day/month for the various categories

Sl. No.	Category & Competency / Skill-level required	Service Charge payable per day (8 hrs)	Service Charges payable for a month (in case of 26 Working days)
1.	Semi-Skilled Manpower (Matric) Technical Helper	Rs.225/-	Rs.6,750/-
2.	Skilled Manpower (ITI etc) Fitter , Machinist, Turner	Rs.250/-	Rs.7,500/-
3.	Technical Personnel (Diploma in Mechanical Engineering with experience in AutoCAD	Rs.425/-	Rs.12,750/-

SL.NO. 06

FILE NO. ISIR2010019209

ITEM DESCRIPTION : SPACE GRADE AND RAD HARD ANTIFUSE FPGAs

QUANTITY : 100⁺, 125⁺, 150⁺, 175⁺, 200⁺

A. DEVICE DETAILS

The FPGAs shall be ONO antifuse based part number **RH1280B** of gate density 8000 gates or form fit functional equivalent in 172 pin CQFP package & electrical spec as per the SMD 5962F9215603QYC.

B. DEVICE QUALITY

1. Quote for the following quality levels,
 - a. MIL-PRF-38535 QML 'V'
 - b. MIL-PRF-38535 QML 'V' PROCESSED.
2. All the devices shall undergo Pre-cap visual examination on 100% as per of MIL-PRF-38535 QML 'V'. **ISRO reserves right to participate during precap visual inspection or nominate 3rd party for performing Precap Visual inspection.** Quote separately the cost for performing precap by 3rd party. Address and details of the 3rd party to be provided along with the quote.
3. All parts shall be serialized & screened as per QML 'V' of MIL-PRF-38535.
3. The devices shall meet TID requirements of 100Krad (Si) minimum, Single Event Latch Up LET of minimum 80 MeV/mg/cm² and Single Event Upset LET for S-module minimum 3.5 MeV/mg cm² and for C-module minimum 14 MeV/mg cm²
4. The devices shall undergo Group A tests on 100% of the lot.
5. One sample drawn from the deliverable quantity shall undergo Destructive Physical Analysis (DPA) as per the MIL-STD-883 Test Method 5009 (Quote optionally).
6. Three samples shall undergo life test (quote optionally).

C. DATAPACK REQUIREMENTS

The following Data shall accompany the devices in compact disk or soft copy:

1. Certificate of Conformance issued by the manufacturer.
2. Precap Visual Inspection report.
3. Screening results by attributes and variables.
4. Technology Conformance Inspection (TCI) Generic data shall be delivered for the quarter during which these devices are processed.
5. Group B, C & E Test reports.
6. DPA Test report if ordered.
7. Radiation Test report.
8. Life test data with samples if ordered.

D. OTHER REQUIREMENTS

1. The name of the manufacturer shall be specified as part of the offer.
2. Each device type shall be supplied from lots with same date code. The devices shall be drawn from lots manufactured within 2 years of the date of shipment. Supply of devices from lots older than 2 years from the date of shipment shall be indicated in the quotation and will require approval of ISAC before shipment.
3. Devices shall be packed in ESD safe packs, optionally quote for individually vacuum packing
4. The device Leads / Body shall be free from any type of oxidation / corrosion brown spots etc.
5. Only Vendors/Suppliers authorized to source above Space Grade components from the Manufacturer will be considered. Necessary Certificate from the Manufacturer shall be enclosed along with the offer.
6. Alerts / Guidelines / Software & Programmer version / Applications notes shall be enclosed along with the quotation.

E. RESPONSIBILITIES OF THE SUPPLIER

The supplier will undertake following additional tasks to ensure that the devices meet the necessary quality requirements:

1. Monitor manufacturer wherever and perform Final Customer Source Inspection (FCSI). ISRO reserves rights to participate during FCSI or nominate qualified agency to perform FCSI. Quote separately the cost for performing FCSI by 3rd party. Address and details of the 3rd party to be provide along with the quote.
2. Perform 100% Incoming Inspection & Data Package review before shipment.
3. Report to ISAC all NCR/DCN (Document Change Notice) during procurement testing.

Please provide the point-by-point compliance to specification in your quote.

SL.NO. 07

FILE NO. ISIR2010019211

**ITEM DESCRIPTION : RADIATION CROSS LINKED ETFE
INSULATED SPACE GRADE WIRES**

QUANTITIES

SL. NO.	WIRE GUAGE (Single core wire)	QUOTE IN SLABS
01	20 AWG	2 KM ⁺ , 5KM ⁺ , 8KM ⁺ , 10KM ⁺
02	22 AWG	2 KM ⁺ , 5KM ⁺ , 8KM ⁺ , 10KM ⁺
03	24 AWG	2 KM ⁺ , 5KM ⁺ , 8KM ⁺ , 10KM ⁺
04	26 AWG	5KM ⁺ , 10KM ⁺ , 15KM ⁺ , 20KM ⁺ , 25KM ⁺
05	28 AWG	2 KM ⁺ , 5KM ⁺ , 8KM ⁺ , 10KM ⁺

SPECIFICATION :

Offered Wires shall be ESCC Qualified, radiation cross linked ETFE insulated Wires on silver plated copper.

I. QUALITY REQUIREMENTS:

1. As per Generic Specification : ESCC 3901/012

II. WIRES SPECIFICATION :

- | | |
|---|---|
| 1. Insulation material | : Radiation Cross linked ETFE |
| 2. Conductor type | : Silver Coated Copper |
| 3. Operating temperature | : -65° C to +200°C |
| 4. Wire gauge | : Quote for 20, 22, 24, 26 & 28 AWG Wires |
| 5. Wire color (Outer jacket) | : White |
| 6. Description | : Single wall Hook up |
| 7. Dielectric Breakdown | : 27KV |
| 8. Volume resistivity | : 10^{16} Ω -Cm |
| 9. Dielectric constant | : 2.7 |
| 10. Dissipation factor | : 0.001 |
| 11. Insulation Resistance | : 1500Mega Ohms/KM |
| 12. Total dose radiation
Withstanding capability | : 500 Mega Rad Minimum |

III TEST REQUIREMENTS:

1. Final production test (Chart II)
2. Offer separate quote for LAT-II & LAT III test.

IV DATA PACKAGE:

As a minimum the following shall form the data package supplied along with The wires.

1. Certificate of conformance.
2. Final production test data.
3. LAT2 & LAT3 test is data if the test is ordered .

V OTHER REQUIREMENTS:

1. The manufacturer of the offered product shall be listed/certified in ESCC QPL.
2. The wires shall be resistant to electrical arcing tracking in wet or dry Conditions.
3. Certificate / results showing the radiation withstanding capability.
4. ESCC part number & logo shall be printed on the supporting spool.
5. Each line item shall be from a single lot date code.
6. Wires offered shall be of date code not older than 2 years from the Date of shipment.

- 7, Party shall provide letter / certificate from the manufacturer indicating That the party is an authorized agent / distributor for the parts Quoted.
8. Party offering the bid shall have experience of supplying the space grade & military grade parts. A reference or proof of the same shall be Provided along with the quotation.

SL.NO	SPECIFICATION	REMARKS
1.	GENERIC SPECIFICATION	
2.	INSULATION MATERIAL	
3.	CONDUCTOR TYPE	
4.	OPERATING TEMPERATURE	
5.	WIRE GAUGE	
6.	WIRE COLOR (OUTER JACKET)	
7.	WHETHER SINGLE WALL HOOK UP WIRE	
8.	DIELECTRIC BREAKDOWN	
9.	VOLUME RESISTIVITY	
10.	DIELECTRIC CONSTANT	
11.	DISSIPATION FACTOR	
12.	INSULATION RESISTANCE	
13.	RADIATION CAPABILITY	
14.	FINAL PRODUCTION TEST (CHART II)	
15.	WHETHER LAT II & III OFFERED	
16.	CERTIFICATE OF CONFORMANCE	
17.	DATA PERTAINING TO FINAL PRODUCTION TEST	

18.	DATA PERTAINING TO LAT2 & LAT3	
19.	MANUFACTURER OF THE OFFERED ITEM	
20.	RESISTANT TO ELECTRICAL ARC TACKING	
21.	PROOF OF RADIATION HARDNESS LEVEL	
22.	ESC PART NUMBER & LOGO ON THE SPOOL	
23.	SINGLE LOT DATE CODE	
24.	DATE CODE LESS THAN TWO YEARS	
25.	AUTHORISATION LETTER	
26.	HERITAGE (IN SUPPLY OF MIL-GRADE PARTS)	

Kindly send the duly filled compliance matrix along with the quotation for necessary speedy action otherwise offers may not be considered.

SL.NO. 08

FILE NO. ISGE2010019275

DESCRIPTION OF ITEM: VECTOR NETWORK ANALYSER

QUANTITY : 01 (ONE ONLY)

SL. NO	PARAMETER	SPECIFICATION
01	Type	Vector Network Analyser
02	Frequency Range	100 MHz to 20 MHz
03	Frequency Resolution	1 Hz
04	Power Output	-30 dBm to + 5 dBm
05	Power Level Linearity	<1 dB
06	Power Resolution	0.01 dB
07	Dynamic Range	>100 dB

08	IF Bandwidth	10 Hz to 35 KHz selectable
09	No. Of Ports	Two
10	Accuracy of transmission measurement	<0.2dB or 2° for 5 dB to -30 dB range
11	Accuracy of reflection measurement	<1 dB or <6° for -15 dB to -25 dB range
12	Frequency accuracy	8×10^{-6}
13	Damage input levels	Better than +20 dBm
14	Directivity	35 dB
15	Source match	30 dB
16	Load match	35 dB
17	RF connector interface for test ports	3.5mm SMA connectors, 50 ohms
18	Display	Color display (LCCD)
19	Calibration	Guided, TRL/TRM
20	Input / Output interface	VGA, USB (2 numbers), LAN
21	Cross talk	>80 dB
22	Power supply compatibility	230 V, 50 Hz
23	Operating system	Windows 2000 & latest
24	Internatal storage	10 GB
25	Calibratiuon & Repair support period	10 years (Minimum)
26	EMC compatibility	IEC/EN61326 standard /equivalent

SL.NO. 09

FILE NO. ISGE2010019117

DESCRIPTION OF ITEM: 192 CHANNEL ACOUSTIC DATA ACQUISTION SYSTEM

QUANTITY : 01 NO.

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Detailed Specification for 192 Channel Acoustic Data Acquisition System

1. Introduction

- 1.1. The Acoustic Data Acquisition System will be used for acquiring and performing analysis of vibration data obtained during Acoustic Testing of Spacecraft and subsystems.
- 1.2. The system is required to support 192 channels of voltage and acceleration expandable upto 256. Both software and hardware are required to be highly modular in structure to render the operation and maintenance easier. **The modularity is required for easy scalability of the system for future requirements.**
- 1.3. The system should have proven heritage with installation base in aerospace industry for similar requirements and applications, mainly with data acquisition during dynamic testing of Spacecraft.
- 1.4. The vendor should provide quote in two parts as per the purchase department/tender directives – Techno-commercial quote and the price bid.
- 1.5. The Techno-commercial quote should consists of the following
 - 1.5.1. The technical quote with detailed list of hardware and software being quoted.
 - 1.5.2. Compliance Matrix indicating compliance of the quoted system to the specification. Any deviation from the specification to be clearly spelled out in the Compliance Matrix for the specifications. The Compliance Matrix should clearly indicate the part numbers required to be supplied by the vendors to meet each specification including those shown as **“(OPTIONAL)”**.
 - 1.5.3. The overall system configuration schematic provided with detailed notes.
 - 1.5.4. All the technical details with related technical papers / catalogues / drawings in support of the compliance to the specifications.
 - 1.5.5. Unpriced commercial quote with all the commercial terms clearly spelt out. This should be identical to the price bid except for the price column, which is left blank.
 - 1.5.6. Any additional hardware/software that may be required to meet the optional requirements should be separately quoted.

- 1.6. The Price bid should provide cost break-up of the major subsystems (both hardware and software) and of the individual spares of the Data Acquisition System.
- 1.7. ISRO-ISAC reserves the right to include/exclude any of the software or hardware modules at the time of ordering.
- 1.8. It should be noted that functional specifications can override hardware specifications.

2. Instrumentation Front End

Sl. No.	Features	Range/value
2.1.	Number of Input Channels	192, expandable upto 256.
2.2.	Number of Output Channels	4
2.3.	Input/output connectivity to instrumentation front end	BNC Connector.
2.4.	Signal conditioning.	<ul style="list-style-type: none"> • Programmable signal conditioning modules that support voltage input and IEPE (integral electronic piezo-electric) accelerometers on all channels. • Option to select AC, DC or IEPE on each channel.
2.5.	IEPE signal conditioning	<ul style="list-style-type: none"> • Compliance voltage : 24V nominal; • Current : 4mA nominal; User selection from 2mA to 10mA preferred.
2.6.	ADC	<ul style="list-style-type: none"> • 24Bit ADC. • Individual ADC for each channel. • Each input channel should be capable of sampling upto 100kHz and, when combined, the system should be able to support upto 256 channels with 50KHz sampling rate. • Synchronized sampling for all channels.
2.7.	DAC	<ul style="list-style-type: none"> • Each output channel should have 24bit DAC.
2.8.	Anti-aliasing Filter	On all channels with anti-aliasing protection of greater than 70dB.
2.9.	Maximum input voltage	<ul style="list-style-type: none"> • 10Vpk maximum (20V peak to peak bipolar) • The system should be protected for over voltage protection of at least two times the maximum input voltage (i.e., 40V peak to peak)
2.10.	Input Dynamic Range	96dB or better, with a noise floor of -120dB.
2.11.	Input impedance	Greater than 1MOhms.
2.12.	Cross Talk between channels.	Better than -90dB.

Sl. No.	Features	Range/value
2.13.	Common Mode Rejection Ratio (CMRR)	Better than 50dB.

2.14.	Synchronization	All the responses that are monitored are to be digitized simultaneously with synchronized sampling so as to achieve phase difference of better than 1.0degree between channels upto 10KHz.
2.15.	Digital Signal Processor (DSP)	<ul style="list-style-type: none"> Dedicated DSPs built-in to the Instrumentation Front-end for a set of channels for the purpose of on-line analysis of acquired time domain data. The quote should include the DSP architecture configuration.
2.16.	Throughput Recording	<ul style="list-style-type: none"> For on-line acquisition and storage of Raw time domain data of test of minimum 10 minutes duration with 50KHz sampling rate, 24 bit ADC and 256 channels (resulting in transfer rate of >51.2MB/Sec & storage capacity requirement of 62 GB or more). Redundancy of data storage while carrying out on-line acquisition and storage – either in terms of disk mirroring or providing additional parallel storage media such as Solid state Drives. The throughput disk module should support data acquisition of SIX tests continuously without transferring data to the back-up drive resulting in storage requirement of 350GB. In case of abrupt termination of data recording due to any reason (including power-off, software malfunction, instrumentation front-end malfunction), the raw-time domain data stored till that moment should be readable.
2.17.	Interface to Computer	High speed connectivity such as Ethernet or Firewire between the instrumentation frond end and the computer. The connectivity should support the high data rate emanating from 50KHz sampling rate, 24 bit ADC and 256 channels (resulting in transfer rate of 51.2MB/Sec or better)

Sl. No.	Features	Range/value
2.18.	Calibration	<ul style="list-style-type: none"> • It should be possible to carry out ON-SITE Instrumentation front-end calibration without the need of support/intervention from the vendor. • Any H/W & S/W accessories for the same shall be provided. • Offset removal and gain linearity adjustment for all the input/output channels should be provided. • In case if any channel fails in calibration, the calibration process should continue skipping that particular channel. It should be possible to isolate/disable the failed channel in further calibration steps.
2.19.	RACK for mounting	Portable rack on wheels for housing Instrumentation Front-end should be supplied.

3. Computer

Sl. No.	Features	Range/value
3.1.	The computer should be a reliable one with following specifications.	
3.2.	Operating System	Microsoft Windows XP or better or Linux
3.3.	Platform	<ul style="list-style-type: none"> • Intel Core i7 (4 core or more) 64 bit processor with 3.2GHz clock rate OR Better. • 8MB level 2 cache or better • 1066MHz system bus or better. • Intel Original Chipset. • Vendor has to ensure that the computer platform chosen is sufficient to meet the overall functional requirement (particularly data throughput) of the data acquisition system.
3.4.	RAM	8GB DDR3 expandable to 16GB
3.5.	Hard disk	<ul style="list-style-type: none"> • 250GB or better HDD for Operating System with disk mirroring (with boot option from either of the disks). • 500GB or better HDD for Data with disk mirroring. The HDD capacity should meet the storage requirements of specification item 2.16. • Disk mirroring with RAID features for both system and data disks.

Sl. No.	Features	Range/value
3.6.	Display	<ul style="list-style-type: none"> Two numbers of 24" full HD TFT LCD monitors with 1920 x 1080 resolution or better. The monitors should be connected in master-slave configuration.
3.7.	DVD-R/W Drive	20X or better DVD Super Multi double-layer drive with DVD and CD read-write capability.
3.8.	Blu-Ray R/w Drive	External Blu-Ray R/W drive with 20 no. of write-once blank Disk media.
3.9.	I/O ports	<ul style="list-style-type: none"> USB 2.0 – 6 no.s. Parallel Ports : 1 no.
3.10.	Pointing Device	USB Optical Scroll mouse.
3.11.	Keyboard	Full sized keyboard with integral numeric keypad.
3.12.	Networking	<ul style="list-style-type: none"> 1Gbps Ethernet LAN. LAN speed should sufficiently large enough to support the high data rate described in 2.17. One Additional 1Gbps Ethernet LAN to connect computer to ISRO-ISAC network. One 8/12 port 1Gbps network switch.
3.13.	Printing	<ul style="list-style-type: none"> 1 No. Color Laser jet Printer with built-in network port & USB port, and, with double side (duplex) printing capability.
3.14.	SMPS	SMPS of required rating with Hot redundancy

4. Software

4.1 Basic System Software Features

Sl. No.	Features
4.1.1.	The software should cater for acquisition and analysis of vibration data for satellites and their subsystems.
4.1.2.	Software should support on-line acquisition and throughput of time domain data of all the channels with the maximum sampling rate during all modes of test data acquisition using built-in throughput disk.
4.1.3.	The modules for test data analysis should permit on-line, multi-channel real time analysis and display as well as post processing of raw time domain data both in frequency domain and in time domain.
4.1.4.	The software should be able to display the data of a selected set of channels both in frequency domain and in time domain during acquisition in real time.
4.1.5.	Provision should exist for selecting the channels randomly for acquisition.
4.1.6.	Following pre-acquisition parameters should be user selectable in spreadsheet style setup in all the software packages. <ul style="list-style-type: none">• Setting-up of measurement channels before the start of acquisition process.• Manual Input of calibration factor, channel sensitivity.• Provision should exist for tagging the channel names.• Amplitude conversion factor to convert Incoming signal voltage to Engineering Unit.
4.1.7.	Following features should be available with respect to pre-acquisition setup. <ul style="list-style-type: none">• Storing of channel configuration data in file for future recall.• Printing of channel parameters• Storing of the setup parameters along with the data after acquisition.• Importing of setup parameters from ASCII file.
4.1.8.	Method of Data Capture (Trigger) <ul style="list-style-type: none">• Through manual command using keyboard/mouse.• Transient triggering by waiting for a transient (impulse) to occur before acquiring the data.• Positive, Negative and Bi-polar trigger signal.
4.1.9.	Time duration of acquisition for throughput at maximum sampling rate on all channels – Minimum of 600 seconds.

Sl. No.	Features
4.1.10.	Provision should exist for time domain data display of all channels for the purpose of verification prior to acquisition
4.1.11.	Following display features should be provided in all the software packages.
4.1.11.1.	Data of a single channel should be displayable with option for peak picking.
4.1.11.2.	<p>Provision for data display in a single window for comparison either with over plotting, or with tiled display of</p> <ul style="list-style-type: none"> • Multiple channels of single test (i.e. within the same set of data) • Multiple channels data from multiple tests <p>Data of multiple channels of single and multiple tests should be displayable in multiple windows.</p>
4.1.11.3.	Waterfall display of the selected channel.
4.1.11.4.	Zooming of a selected band in the graph should be possible.
4.1.11.5.	Data tracking cursor for identifying graph values should be provided. It should be possible to mark multiple peaks using single cursor.
4.1.11.6.	Manual & Automatic setting of the range for X and Y-axes.
4.1.11.7.	Option to set Linear/logarithmic scale for X and Y-axes.
4.1.11.8.	Option to enable/disable grid lines.
4.1.11.9.	Hard copy printing option for all the above display plots. Software should be able to support the general LaserJet printers and in particular the Color LaserJet printer supplied along with the system.
4.1.11.10.	<ul style="list-style-type: none"> • Facility should be present to save the display plots in PDF format and optionally PS format, as well as importing them into applications like Microsoft word for report generation purpose. • It should be possible to export all plots of a test at once to MS word with optional peak picking for each of the plots.
4.1.11.11.	Option to list identified points on the graph along with the graph should be available. This feature should be supported in hard copy generation also.
4.1.12.	<p>The software should support export of the data files in the following file formats.</p> <ul style="list-style-type: none"> • Universal File Format - data set 58 and other data sets. • Spread sheet format (Microsoft Excel). • ASCII format.

Sl. No.	Features
	<ul style="list-style-type: none"> ● MATLAB Binary and MATLAB ASCII. Importing of data in Universal File Format should be possible.
4.1.13.	Provision for initial diagnostics of the instrumentation front end in case of any hardware problems.
4.1.14.	Provision for on-site Instrumentation Front-end Calibration should be provided with Calibration Software and associated accessories for field calibration as per specification 2.18.
4.1.15.	Source Control Program to generate sine, random, burst sine, burst random and user defined signals for Modal Testing. The software should be able to generate mutually uncorrelated signals for each of the channels. Each of the four output channels should be independently programmable.
4.1.16.	The modal analysis software should be able to support
4.1.16.1.	MIMO FRF estimation using H1, H2 and Hv Estimators.
4.1.16.2.	Compute ordinary coherence, multiple coherence and virtual coherence for each of the input channels.
4.1.16.3.	Exporting of the processed data in the formats defined in 4.1.12 for further analysis.
4.1.16.4.	Recording and storage of the raw time domain data along with the processed data.

4.2. Acoustic Response data Analysis

Sl. No.	Features
4.2.1.	The Software module should support data acquisition and analysis of the responses monitored at various locations on the test specimen during Acoustic test.
4.2.2.	Real time FFT operation to be performed and displayed to obtain frequency domain transformation of the time domain signal.
4.2.3.	Following pre-acquisition parameters should be user selectable. These are in addition to the parameters described above in section 4.1.
4.2.3.1.	Frequency Range selectable from 0 - 10Hz to 0 - 40KHz in discrete steps.
4.2.3.2.	Sampling rate selectable from 25 to 100KHz in discrete steps.
4.2.3.3.	Number of spectral lines - 100 to 16384.
4.2.3.4.	Number of averages - 1 to 1000.

4.2.3.5.	Type of Averaging. <ul style="list-style-type: none"> • Linear • Peak Hold • Exponential averaging • No Averaging
4.2.3.6.	FFT overlap definable in percentage from 0% to 90% (OPTIONAL)
4.2.3.7.	Windowing function <ul style="list-style-type: none"> • Hanning, • Keiser Bessel, • Rectangular, • Exponential,
4.2.4.	Off-line analysis of the stored time domain data should be possible. In off-line analysis, it should be possible to perform analysis with frequency range that is lower than the one defined during acquisition.
4.2.5.	The following analysis features should be possible in both on-line and offline. <ul style="list-style-type: none"> • Power Spectral Density function of a given channel, • Cross spectral density function between any two channels, • Auto Correlation of a given channel and cross correlation between any two channels • Coherence function (defining the linear dependency between two signals over a given frequency range) between any two channels, • Octave analysis with option to select Order of analysis from 1/1 Octave to 1/24 octaves or better. • Phase spectrum between any two channels, • Real and imaginary plot (with respect to frequency) of a spectral density function for any channel. (OPTIONAL) • Transmissibility (FRF) – amplitude and phase transfer function of a channel with respect to another channel. • Along with the display of the plot of the selected channel, statistical parameters such as rms, maximum and minimum amplitude with frequency, etc., should be displayed. The following analysis features should be supported in off-line analysis mode. <ul style="list-style-type: none"> • Integration and Differentiation of a given channel. • Nyquist plot between two channels. (OPTIONAL)
4.2.6.	Spectral weighting for Acoustic Data Analysis

	<ul style="list-style-type: none"> • A weighting, • B Weighting, • C Weighting, etc.
4.2.7.	Along with the display of the plot of the selected data channel, statistical parameters such as Overall Sound Pressure Level, maximum and minimum amplitude with frequency , etc., should be displayed.

4.3. Sine Data Acquisition and Analysis

Sl. No.	Features
4.3.1.	The system should support swept sine data analysis. The Software module should support data acquisition and analysis of the responses monitored at various locations on the test specimen during swept sine test. Simultaneous on-line acquisition, recording and analysis (as per item 4.3.2 below) of the time-domain data in real time are preferred.
4.3.2.	The acquisition process should adopt frequency estimation technique where, instantaneous frequency information is obtained by counting the number of zero crossings in a frequency reference signal and computing the frequency value or equivalent. Amplitude of all the data channels should be obtained by estimating the instantaneous amplitude value of the corresponding channels.
4.3.3.	Both filtered response (the response at the fundamental excitation frequency only, with the contributions of other frequencies removed) and overall or unfiltered response (response over the entire selected frequency range) should be computed and stored separately along with the phase information. It is preferred to have simultaneous computation of both filtered and unfiltered responses.
4.3.4.	The phase response of a given channel should be computed with respect to the filtered response of the channel.
4.3.5.	The bandwidth selected for computation of the filtered response (amplitude) can be either, <ul style="list-style-type: none"> • Proportional Bandwidth • Fixed Bandwidth.
4.3.6.	Provision should exist to concatenate multiple runs of a single test for the purpose of display and plotting.
4.3.7.	Off-line analysis of the stored time domain data should be possible. In off-line analysis, it should be possible to perform analysis with frequency range that is lower than the one defined during acquisition.
4.3.8.	Frequency Range from 5Hz to 20KHz with corresponding sampling rate

	from 12.5Hz to 100KHz
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4.4. Transient Data Acquisition and Analysis

Sl. No.	Features
4.4.1.	The system should support acquisition and processing of transient data as well as to process the data stored in disc, both in time and frequency domains.
4.4.2.	It should be possible to carry out the following operations on the time domain signal before computing SRS. <ul style="list-style-type: none"> • Filtering of the signal with low pass / band pass filters with user defined cut-off frequencies. • DC offset removal. • Trend removal.
4.4.3.	Shock Response Spectrum (SRS) Analysis with following parameters user selectable. <ul style="list-style-type: none"> • Damping - 1 to 99%. • Frequency Range - up to 20KHz. • Octave analysis Definition <ul style="list-style-type: none"> o 1/1 Octave o 1/3rd Octave o 1/6th Octave o 1/12th Octave o 1/24th Octave
4.4.4.	Display of following SRS plots with option of displaying them in a single window (either overlapping of the SRS plots or displaying one next to another) along with time domain signal. <ul style="list-style-type: none"> • Primary, Residual, Positive, Negative and Maximax SRS.
4.4.5.	Off-line analysis of the stored time domain data should be possible.

4.5. Mathematical Processing

Sl. No.	Features
4.5.1.	Following operations should be possible on acquired raw time domain data and processed data.
4.5.1.1.	Data-Data arithmetic (+, -, * and /) between any two selected channels.

4.5.1.2.	Data-Constant arithmetic (+,-,* and /) for a selected channel with data in real/complex/magnitude-phase format.
4.5.1.3.	Integration and differentiation of a given channel data.
4.5.1.4.	Application of trigonometric functions to a given channel data. The functions should include sin, cos, tan, arcsin, arctan, arcos, & their hyperbolic functions.
4.5.1.5.	Curve fitting operations such as smooth fit and least-square polynomial fit. Removal of spikes from data.
4.5.1.6.	Signal manipulation such as Append signal to Dataset, Copy whole signal, Extract named elements, Repair signal, Replace signal, Include signals to dataset, Copy section of signal, etc.
4.5.1.7.	Filtering operations – low pass, high pass, band pass and band stop – with Bessel and Butterworth filter characteristics.
4.5.2.	Ability to add user defined routines using built-in programming environment or routines developed using MATLAB/C/C++/Java programming environments. It should be possible to invoke these used defined routines within the acquisition and analysis packages defined above.

5. Essential Spares Kit

Sl. No.	Features	Range/value
5.1.	Computer	The computer with all peripherals except Monitor should be supplied as essential spares to ensure 100% uptime in case of failure.
5.2.	Throughput Disk	Additional throughput disk module should be supplied as essential spares to ensure 100% uptime in case of failure.
5.3.	Instrumentation front end	<p>The cards/boards of instrumentation front end, that are the source of single point failures, should be part of the Spares kit. In particular at least following cards should be included.</p> <ul style="list-style-type: none"> • The Master card or its equivalent that sits in the mainframe and controls the instrumentation front end • Signal conditioning and A/D converter card(s). • Clock/synchronization card if any. • The interface kit to connect the Computer and the Instrumentation Front-end. • Power supply module for the instrumentation front end.

Sl. No.	Features	Range/value
		This list will be finalized after looking into the configuration proposed by the vendor at the time of ordering.

6. Electrical Power Supply & Operating Environment

The supplied hardware should be able to run with the following electrical supply and environmental conditions. The vendor should supply the system with India compatible power-cords.

6.1. Electrical Supply

Sl. No.	Features	Range/value
6.1.1.	Voltage	220 Volts AC +5% and -10%
6.1.2.	Frequency	50 Hz \pm 1.5%

6.2. Operating Environment

Sl. No.	Features	Range/value
6.2.1.	Operating and storage temperature	10°C to 40°C
6.2.2.	Relative Humidity	10% to 90%

7. System Demonstration

Sl. No.	Features
7.1	The vendor should demonstrate complete capabilities of the system at ISRO-ISAC, Bengaluru, in particular, the system with at least two chassis configuration to show synchronization. Results of this demonstration will form basis for technical qualification of the system.

8. System Acceptance

Sl. No.	Features
8.1.	Fully integrated Data Acquisition System should be completely tested prior to dispatch and these test results shall be made available. ISRO-ISAC may witness the pre-shipment acceptance test, at their discretion.
8.2.	The quotation should contain the details of the tests to be conducted at factory and also at ISRO-ISAC site along with the report format covering performance specifications.

8.3.	Mutually agreed acceptance tests carried out at ISRO-ISAC site shall form the basis for final acceptance of the system.
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9. Installation & Training

Sl. No.	Features
9.1.	Training should be provided for the ISRO-ISAC personnel.
9.2.	The system should be installed at ISRO-ISAC and demonstrated for full performance rating of the system.

10. Warranty and Maintenance

10.1	<ul style="list-style-type: none"> Warranty period for the hardware and software shall be for a minimum period of THREE YEARS. Warranty period should begin only after installation and commissioning at ISRO-ISAC Site. Warranty is ON-SITE warranty only.
10.2	Cost of post-warranty period support for the system should be indicated with year-wise breakdown for THREE years after warranty period.
10.3	Post sales support (operation support and maintenance) available locally should be spelt out clearly. Availability of the local support will form the basis for technical qualification of the system.
10.4	<p>The maintenance agreement should incorporate the following.</p> <ul style="list-style-type: none"> Supply of updates for Application software and Operating System software as and when they are introduced. Supply of bug fixing versions of the software. Software and hardware should be considered as separate entities while quoting for maintenance and servicing.
10.5	The vendor should support spares for 10 years from the date of installation.

11. General

Sl. No.	Features
11.1	The vendor should provide list of installation base (systems installed with the same model number and similar configuration as quoted like number of channels and the software packages supported) in aerospace industry with contact details that includes contact person's name, postal address, email address and telephone number. It should be noted that this information will be used for evaluation of the quoted system for technical

	suitability.
11.2	<p>Hard copy as well as soft copy of the User Manual and Service Manual for the following should be provided.</p> <ul style="list-style-type: none"> • Operating system • Computer hardware • Instrumentation hardware • Application Software
11.3	The vendor should supply the Application Software and Operating system software in CD/DVD media.
11.4	Any options and accessories required in the vendor's opinion, but not indicated in this specification should be quoted separately.
11.5	In case of software licensing, clearly spell out the possible options available, like dongle based licensing, computer mach id based licensing, etc.

SL.NO. 10

FILE NO. ISGE2010019132

**DESCRIPTION OF WORK : THERMAL FABRICATION
AND IMPLEMENTATION OF VARIOUS ELEMENTS**

STATEMENT OF WORK

ON

THERMAL FABRICATION AND IMPLEMENTATION ON
SATELLITES

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1.0 INTRODUCTION

ISRO Satellite Centre (ISAC) at Bangalore is developing satellite technology and implementation of satellite systems for scientific, technological and application missions.

Thermal Fabrication Division (TFD) of Thermal Systems Group (TSG) of ISAC is engaged in delivering a suitable Thermal Control Subsystem (TCS) to various satellites so as to maintain and control the temperatures at various locations of the spacecraft. It involves fabrication and implementation of various thermal elements like Optical Solar Reflectors (OSR); Multi Layer Insulation (MLI) blankets; Heaters; Thermal tapes; Thermistors & PRTs; Paints; thermal grease; etc. and carrying out Electro-chemical processes on spacecraft components;

In the following sections of this document, the scope of work, brief descriptions of the relevant thermal control elements, nature of work, and quantities of work, fabrication and implementation procedures, manpower estimations, general precautions / work instructions etc. are explained.

2.0 SCOPE OF WORK

The various TCS hardware fabrication and implementation works which are to be contracted out consists of mainly the following:

- 1. Electro-chemical processes on aluminium alloys, and magnesium alloys**
- 2. Thermal painting**
- 3. Rigid Optical Solar Reflectors (OSR) bonding**
- 4. Foil heaters fixing**
- 5. Tape heaters fixing**
- 6. PRT / Thermistors bonding**
- 7. Thermal control tapes fixing**
- 8. Thermal grease application**
- 9. Multi Layer Insulation (MLI) blankets fabrication and assembly**
- 10. Heat Shields fabrication and assembly**

3.0 NATURE OF WORK.

In general the thermal activities involve preparation of implementation drawings, carrying out the thermal fabrication and assembly works as per the procedures and entering the details in log sheets.

The following gives the brief description of the nature of work for various thermal works.

3.1 Electro-chemical process:

It involves carrying out various electro-chemical processes on spacecraft components made of aluminium alloys and magnesium alloys in chemical baths.

3.2 Thermal painting:

It involves preparation of drawings for painting locations on various parts of the spacecraft packages, masking and application of black paints and white paints on panels, packages, antennae reflectors, polyimide foils etc., using compressed air spray gun. Some times chemical etching is to be carried out for the anodic coating on aluminium substrates before masking & painting.

3.3 Rigid Optical Solar Reflectors bonding:

It involves OSR layout drawings preparation, bonding OSR pieces on the equipment panels with adhesive using fixtures and curing the adhesive with Infrared lamps.

3.4 Foil heaters, Tape heaters and Thermal control tapes fixing:

It involves sizing of the heater elements and heater circuit design, preparation of heater implementation drawings, and fixing the heaters. The foil and tape heaters are fixed on panels and packages with transfer adhesive Thermal tapes are supplied by the manufacturer with self adhesive backing. The tapes are fixed on the panels and packages by removing the release paper and sticking it to the surface.

3.5 PRTs and Thermistors bonding:

It involves preparation temperature sensor location drawings, fixing temperature sensors at various locations on the spacecraft/packages. These temperature sensors are fixed using various one part or two part adhesives, or to be fixed with Kapton adhesive tapes etc.

3.6 Thermal grease application:

It involves applying thermal grease, which is in the form of thick paste, on the mounting surfaces of the packages using nylon screen mesh.

3.7 Multi Layer Insulation (MLI) Blankets fabrication & assembly:

It involves Velcro tape locations drawings preparation, bonding velcro tapes on various spacecraft packages, equipment panels which are to be covered with MLI blankets, MLI blanket template preparation, compiling various layers of the blankets, cutting the blankets with scissors & knives, fixing grounding tapes and Kapton adhesive tapes, buttons stitching the layers with nylon thread, bonding velcro tapes on the blankets, and assembling the blankets on the spacecraft.

3.8 Heat Shield fabrication & assembly for AOCS thrusters and LAM

It involves drawings preparation, fabricating the cone shield with SS / Titanium sheets and assembly using ceramic beads / SS wires, spot welding and final assembly on spacecraft using polyimide spacers & ceramic washers.

4.0 QUANTITY OF WORK (for two years):

SI No	Item Name	Quantity	Unit	Work contract in man-	Man power required
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				hours	
1	Electro-chemical process for Al, Mg, Cu, Ti, SS etc. components:				
1.1	Small components (like washers, fasteners, spacers etc)	12000 No	Each unit	4900	0.98
1.2	Medium components (like brackets, mechanism components, etc)	9000 No	Each unit	6600	1.32
1.3	Large components (like boxes, modules etc)	1600 No	Each unit	11600	2.32
2	Thermal painting	300 m ²	Each sq mtr	14300	2.87
3	OSR bonding	29 400 No.	Each unit	28300	5.67
4	Foil heater fixing	1500 No	Each unit	7800	1.58
5	Tape heater fixing	640 m	Each mtr	8700	1.73
6	PRT / Thermistor bonding	690 No	Each unit	5800	1.16
7	Thermal control tape fixing	40 m ²	Each sq mtr	2700	0.55
8	Thermal Grease application	330 No.	Each unit	7500	1.49
9	MLI fabrication & implementation	340 m ²	Each sq mtr	17600	3.53
10	AOCS Heat shields fabrication & Assembly	218 No.	Each unit	6200	1.25
11	LAM Heat shields fabrication & Assembly	10 No.	Each unit	2700	0.54

Total manpower required:

BE/Msc (chem)- one No., BE (mech.)-2 No,

DME(chem)- 2No., DME(mech)- 5No.,

ITI (electroplating)-3 No, ITI (electrical)-2 No., ITI (fitter)-10 No. **Total= 25 No**

It may be noted that all components or assembled system for any of the above mentioned activities would not be available simultaneously or sequentially. They would be available intermittently over a period of two years. However it is essential to depute all the personnel as per the manpower estimations mentioned in para 10.0.

5.0 PLACE OF WORK AND WORKING HOURS:

PLACE OF WORK:

The electro-chemical process activities are to be carried out at Electro chemical laboratories of Thermal Systems Group of ISAC. The Electro chemical Laboratories are situated in Liquid Systems Propulsion System Centre (LPSC) campus at Bangalore.

Thermal painting activities are to be carried out at the painting booth situated in TSG of ISAC, Bangalore.

The rigid OSR bonding works on the panels / packages are to be carried out in thermal laboratories or spacecraft integration clean rooms, ISAC / ISITE, Bangalore.

In general, the remaining activities namely MLI blanket works, Temperature sensors bonding, Heater fixing, Thermal tapes fixing, Thermal grease application, etc. are to be carried out at thermal laboratories or spacecraft integration clean rooms at ISAC / ISITE, Bangalore. However, some times these activities are to be carried out in other units of ISRO, i.e. at Space Application Centre-Ahmedabad, Satish Dhawan Space Centre-Sriharikota, Vikram Sarabhai Space Centre-Thiruvananthapuram etc. Necessary TA / DA at the rates applicable to Technicians of ISAC for the persons deputed to other ISRO Centres for Project related activities will be borne by ISAC.

WORKING HOURS:

Normally the working hours is restricted to the working hours of ISAC (8.30 AM to 5.00 PM) upto 6 days a week basis. However contract personnel should be ready to stay beyond office hours, Sundays and general holidays, if necessary to complete the scheduled activities/tests/processes. In addition, if required the contract manpower will be deployed in three shifts of eight hours duration, round the clock.

6.0 DESCRIPTION OF ELECTRO-CHEMICAL PROCESSES AND THERMAL CONTROL ELEMENTS:

6.1 ELECTRO-CHEMICAL COATINGS ON ALUMINIUM AND MAGNESIUM ALLOYS

The spacecraft components fabricated out of Aluminium alloys and Magnesium alloys are required to be treated with different electro-chemical coatings for thermal control application. The different electro-chemical processes are Anodizing, Anodizing & black dyeing, Hard anodizing and Integral Black Anodizing (IBA).

Alloys to be handled:

Aluminium Alloys : Al-1100, Al-2024, and Al-6061

Magnesium Alloys : AZ31B AND ZK60A

Processes to be carried out:

Aluminium Alloys : Anodising, Anodising & Black Dyeing, Hard Anodizing.

Magnesium Alloys : Integral Black Anodizing (IBA)

Specifications:

ALLOY	TREATMENT/ PROCESS	COATING THICKNESS	MICRO HARDNESS	IR EMISSIVITY
Alluminium Alloys				
Al-1100 Al-6061 Al-2024	Anodising	15 \pm 5 microns 15 \pm 5 microns 11 \pm 5 microns	> 100 VHN	> 0.75
Al-1100 Al-6061 Al-2024	Anodising and Black Dyeing	20 \pm 6 microns 20 \pm 6 microns 11 \pm 5 microns	> 100 VHN	0.85 \pm 0.05
Al-1100 Al-6061	Hard Anodising	50-75microns	> 300 VHN	> 0.75
Al-6061	Electroplating (Gold/ Silver)	3 -5 microns	>100 VHN	< 0.05
SS, Cu, Ti	Electroplating (Gold/Silver)	3 -5 microns	>100 VHN	< 0.05
Magnesium Alloys				
AZ31B ZK60A	IBA	3-9microns	> 88 VHN	> 0.90

6.2 Thermal Control Paints:

Thermal paints are composed of inorganic pigment, organic binders & solvents. The thermal paints can be black, white and aluminium in colour and electrically conductive or electrically non-conductive. Thermal paints are applied on the spacecraft components as per the established procedure using compressed air spray paint gun and carried out in filtered air, no pump spray painting booth. The paint coating shall have uniform appearance, uniform paint thickness, free from paint defects such as powdery surface, runs or sags, orange peel, interference colours, etc.

6.3 Optical solar reflectors (OSRs):

Optical solar reflectors are thin, delicate and fragile mirrors used for radiating excess heat to the space. The material of construction of these OSRs is either glass or fused quartz. The mirrors are of 80 micron thick in sizes of 40mm x 40mm and 40mm x 20mm. These mirrors are bonded on the spacecraft panels using electrically conductive adhesive.

6.4 Foil heaters:

Foil heaters are thin flexible heating elements consists of an etched foil electrical resistance element laminated between layers of kapton. These are in rectangular shape with areas varying from 5 sq. cm to 30 sq. cm and with resistances varying from 40 ohms to 350 ohms. They are fixed on flat or nearly flat surfaces. These heaters are fixed on the components like spacecraft panels, electronic packages, flow control valves (FCV) using pressure sensitive adhesive.

6.5 Tape heaters:

Tape heaters are heating elements consists of enameled heating elements sandwiched between glass cloth. The top surface is provided with aluminium foil and the bottom surface is with pressure sensitive adhesive. These are available in long strip of 0.5 inch width, with different resistances per unit length. The required length for obtaining the desired resistance is cut from the spool and implemented after connecting the lead wires. They are implemented on tubular and curved surfaces. Tape heater segments are fixed on RCS plumblines, propellant tanks etc. of spacecraft.

Foil and Tape heaters are used on spacecraft components to raise components temperatures to safe operating limit.

6.6 Temperature Sensors(PRTs & Thermistors):

Temperature sensors such as platinum resistance temperature sensors(PRTs) and thermistors are used to monitor and control the temperatures of various elements of the spacecrafts. They are implemented on FCVs, panels, electronic packages, MLI blankets etc. Thermistor is thermally sensitive resistor consists of a small sensing bead and two electrically connected leads.

Platinum resistance temperature sensor (PRT) is a pure platinum film etched / wire wound element encapsulated in ceramic glass. Sensing probe dimensions are 2x5x15mm.

6.7 Thermal Control Tapes:

It is thin kapton layer with thermal control coating on one side and pressure sensitive adhesive on the other side with release paper. Different tapes are used for required optical properties to control the temperature of the spacecraft elements. The different thermal control tapes are aluminized Kapton tape, black tape, OSR tape, germanium tape and gold tape.

6.8 Thermal Conductive Grease:

It is smooth extrudable paste used for improving the contact conductance between the packages and panels. This is applied for payload packages, batteries and heat sinks etc

6.9 Multi Layer Insulation (MLI) Blankets:

The MLI blankets are used on the spacecraft to minimize the heat flow to or from the component, to reduce the amplitude of temperature fluctuations because of time-varying solar radiation fluxes and to minimize the temperature gradients. Multi Layer Insulation (MLI) blankets consist of several layers of low emissive radiation shields separated by thermally low conductive spacers. The layers are perforated for evacuation purpose. The layers are held together by stitching Teflon buttons with Nylon thread at pre-selected locations to avoid relative motion between layers. The assembly is installed on the subsystem perpendicular to the heat flow with Velcro fasteners. To reduce electro static charge build-up on the surfaces of the MLI blankets, all the layers of MLI blankets are grounded.

Due to the complex geometry of the subsystems and large surface areas of the spacecraft panels, the blankets are fabricated in number of segments. The segments are attached with multiple overlap joints, overlap joints and simple butt joints.

6.10 Heat Shields

Liquid Apogee Motor (LAM) and Attitude & Orbit Control System (AOCS) Thrusters are used in Geostationary spacecrafts for orbit raising & attitude correction. These are to be covered with multi-layer metallic radiation shields to prevent heat transfer to the adjacent components.

The heat shield geometry is basically a frustrum of a cone. The shield is covered at top for LAM & open at bottom side and for AOCS thrusters, the shields are open at both ends. For geostationary spacecrafts, one heat shield for LAM, 16 heat shields for thrusters & 4 nos. cylindrical heat shields for AY thrusters are used.

7.0 PROCEDURES:

The standard operating procedures, process information documents required to carry out the work are available with TSG/ISAC and will be made available to the party at the commencement of work. The various steps/sequences for electro-chemical processes, MLI blankets fabrication, fixing of optical solar reflectors, heaters, temperature sensors, thermal control tapes & the procedure for application of thermal conductive grease and thermal painting are explained below.

7.1 STEPS FOR ELECTRO-CHEMICAL PROCESSES:

a) The process sequence for anodising/hard anodising of aluminum alloy is as follows:

- 1) Solvent cleaning
- 2) Alkaline cleaning and rinsing
- 3) Alkaline etching and rinsing
- 4) Masking
- 5) Anodising/Hard anodising and rinsing
- 6) Sealing
- 7) Demasking
- 8) Inspection
- 9) Packing

Process parameters like type of chemicals, bath temp., current densities and time will vary depending on type anodising.

b) The process sequence for black anodising of aluminum alloy is as follows:

- 1) Solvent cleaning
- 2) Alkaline cleaning and rinsing
- 3) Alkaline etching and rinsing
- 4) Masking
- 5) Anodising and rinsing
- 6) Black dyeing and rinsing
- 7) Demasking
- 8) Inspection
- 9) Packing

c) The process sequence for Integral black anodising of Magnesium alloys is as follows:

- 1) Solvent cleaning
- 2) Alkaline cleaning and rinsing
- 3) Acid cleaning and rinsing
- 4) Masking
- 5) Integral Black Anodising and rinsing
- 6) Demasking
- 7) Inspection
- 8) Packing

HT # : Heat treatment in an air circulated oven at 70°C (Only for Integral Black Anodized Magnesium alloy components for 2 hours).

The process parameters should be recorded appropriately in log sheets.

7.2 STEPS FOR THERMAL PAINTING:

- 1) Preparation of drawings for thermal painting on the packages/panels etc
- 2) Cleaning of the surface of the component thoroughly using organic solvents such as trichloroethylene, MEK, toluene etc.
- 3) Deanodise the aluminium components as per the established procedure and as per the deanodizing drawings supplied.
- 4) Application of smooth emery on carbon fibre reinforced plastic (CFRP) components to obtain rough surface, if required, for thermal paint application.
- 5) Final through cleaning as per step (b) if emerying is carried out.
- 6) Measuring & recording of anodic thickness of the components.
- 7) Masking the deanodized and other surfaces which do not require thermal painting using paper and paper-cello adhesive tapes as per the painting drawings.
- 8) Proper mixing of suitable primer and application of primer on the spacecraft components using spray painting gun in painting booth to the required thickness.
- 9) Measuring & recording of primer thickness coated on spacecraft components after allowing desired curing.
- 10) Proper mixing of thermal paint and application off the same on the primed spacecraft components in painting booth to achieve the designed paint thickness in 1st coat.
- 11) Measuring & recording of 1st coat of thermal paint thickness after allowing desired curing.
- 12) Mixing of thermal paint and application of the same on the painted spacecraft components to achieve the desired paint thickness in second final coating.
- 13) Measuring & recording the paint thickness after the desired curing.
- 14) De-masking the painted component and packing the same in polythene sheet.

NOTE: Deanodizing will not be carried out for some components & direct painting will be carried out. For the preparation of black thermal control sheets, only one coat of black painting will be carried out on Kapton sheet as per the established procedure.

7.3 STEPS FOR OSR BONDING:

- 1) Preparation of OSR layout drawing.
- 2) Inspection of OSRs for defects like coating degradation, substrate warpage or any physical damages. Defect free OSRs are to be taken up for primer application.
- 3) Application of primer on rear side OSRs using brush and allowing them for curing for at least 30 minutes.

- 4) Masking of segment of panel as per the supplied autocad generated drawing and priming of the exposed area.
- 5) Preparation of OSR arrays on the jigs as per the drawings.
- 6) Application of adhesive on the panel using screen holder and adhesive wiper and removal of the mask
- 7) Transfer of OSRs on adhesive layer as per the supplied drawing using vacuum pump and removal of jigs from the panel.
- 8) Curing of adhesive layer at 40 deg. C for 2 hours.
- 9) Inspection of bonded OSRs.
- 10) Protective covering for OSRs bonded on the panel.

7.4 STEPS FOR FOIL HEATERS FIXING:

- 1) Prepare the heater implementation drawing.
- 2) Masking of areas as per the supplied drawings before painting OR de-painting of areas as per the established procedure and heater implementation drawing.
- 3) Cleaning of heater mounting surface using cotton cloth soaked with isopropyl alcohol or the recommended solvent.
- 4) Application of pressure sensitive adhesive on mounting surface of the heater without leaving air entrapment.
- 5) Checking of heater for its resistance, damages etc.
- 6) Fixing of foil heaters as per the location shown in the heater implementation drawing. It is the simultaneous operation of removal of silicon coated release sheet from the heater and fixing of heater on the surface. Air or foreign material entrapment shall not be there between the component and heater. Heater once fixed shall not be removed and re-fixed. Hence wrongly fixed heater will become waste. Heaters shall be fixed without straining & disturbing the heating element & crimped joints of the heater.
- 7) Tagging of heaters.
- 8) Measurement of resistances of all heaters and logging them.
- 9) Preliminary QA inspection.
- 10) Interconnection of heater segments by CEFF, ISAC.
- 11) Lead wires anchoring by kapton tape or adhesive.
- 12) Application of thermal control tape on the heater.
- 13) Measurement of eff. resistance, final tagging & powering of heater.
- 14) QA inspection.
- 15) Packing.

7.5 STEPS FOR TAPE HEATERS FIXING:

- 1) Preparation of heater implementation drawings for components.
- 2) Cleaning of components using cotton cloth soaked with isopropyl alcohol.
- 3) Fixing of kapton tape on components.
- 4) Checking of heater for its resistance, damages etc.

- 5) Fixing of tape heater segment as per the location shown in the drawing. It is simultaneous operation of removal silicone coated release sheet, wrapping of heater around components in helical fashion and pressing of heater on components.
- 6) Air or foreign material entrapment shall not be there between the component and heater. Heater once fixed shall not be removed and re-used. Hence wrongly fixed heater will become waste. Heaters shall be fixed without straining or disturbing the heating elements and crimped joints of the heater.
- 7) Tagging of all heaters.
- 8) Measurement of electrical resistances of all heater segments and logging them.
- 9) Preliminary QA inspection.
- 10) Interconnection of heater segments by CEFF
- 11) Lead wires anchoring by kapton tape.
- 12) Application of thermal control tape on the heater.
- 13) Measurement of resistance logging, tagging & powering
- 14) QA inspection
- 15) Packing.

7.6 STEPS FOR THERMISTORS BONDING (ON S/c, PANELS, PACKAGES ETC.):

- 1) Preparation of temperature sensor location drawing.
- 2) Cleaning of thermistor mounting surface using cotton cloth soaked with isopropyl alcohol or the recommended solvent (some times depainting may have to be done at the sensor location).
- 3) Marking of temp. sensor location.
- 4) Checking of sensor for its resistance, damages etc.
- 5) Positioning of sensor at the marked location and anchoring it with thin kapton tapes.
- 6) Mixing of adhesive as per the recommended ratio.
- 7) Application of required amount of adhesive covering the bead, solder joints and part of the extension leads.
- 8) Application of thermal control tape after curing of adhesive for 24 hrs. at room temperature.
- 9) Tagging the sensor.
- 10) Inspection of sensor for its continuity.
- 11) Thermal inspection.
- 12) Packing of the component.

7.7 STEPS FOR PLATINUM RESISTANCE TEMP. SENSORS BONDING (ON MLI BLANKETS)

- 1) Cleaning of PRT mounting surface using cotton cloth soaked with isopropyl alcohol.
- 2) Marking of PRT location.
- 3) Checking of PRT for its resistance, damages etc.
- 4) Positioning of sensor using kapton tape.

- 5) Bonding of sensor using pyralux dry film adhesive with kapton film at high temperature and high pressure for 15 min. A special fixture shall be used while bonding the sensor.
- 6) Checking of sensor for continuity, damages etc.
- 7) Application of thermal control tape.
- 8) Tagging of sensor.
- 9) Thermal QA inspection.
- 10) Packing.

7.8 STEPS FOR THERMAL CONTROL TAPES FIXING :

- 1) Preparation of thermal control tape implementation drawing.
- 2) Cleaning of the surface to be mounted with thermal control tapes.
- 3) Removal of release paper from the tape.
- 4) Fixing of tape by applying pressure on the tape using hand fingers Steps b and c are done simultaneously. There shall not be any air entrapment between tape and the component surface.
- 5) Thermal QA inspection.
- 6) Packing.

7.9 STEPS FOR THERMAL CONDUCTIVE GREASE APPLICATION:

- 1) Cleaning of contact surface of the package and panel using cotton cloth soaked in isopropyl alcohol.
- 2) Marking of the required area to be applied with thermal conductive grease.
- 3) Masking of the other surfaces not to be applied with grease using cello tape and lint free tissue paper.
- 4) Application of 150u-200u thick grease layer using nylon mesh and a wiper.
- 5) Weighing of grease applied on the component.
- 6) Removal of cello tape and lint free tissue paper.
- 7) Removal of excess grease, if any, after mounting of package on the panel.
- 8) Logging of all the information. Name of the package, dimensions of the area applied with grease, total weight of grease applied etc.

7.10 STEPS FOR MLI BLANKET FABRICATION :

The MLI blanket fabrication involves the following operations and should be carried out in the order given below:

1) VELCRO TAPE BONDING ON PANELS / PACKAGES:

- Prepare the Velcro tape locations drawing.

- Identify and mark the Hook Velcro tape locations on the panels / packages as per the drawing.
- Clean the panels / packages with isopropyl alcohol. Make sure that the bonding surface areas of Velcro tapes are clean.
- Apply one coat of adhesive on the rear side of the Hook Velcro tapes with brush and allow it to dry for ten minutes so that the adhesive becomes tacky.
- Apply one more coat of adhesive on the Hook Velcro tape and stick the Velcro tapes on the panel / packages.
- Fix cellophane tapes over velcro tapes to keep the velcro tapes in position and to apply pressure during curing.
- Allow the velcro tapes to cure for 24 hours under room conditions.
- Remove the cellophane tapes and clean the adhesive traces left by the cellophane tapes.
- Prepare the MLI blanket fabrication drawing / template.

2) ROUGH SIZE BLANKET FABRICATION:

- Spread the insulation blanket layer material rolls (Mylar, Kapton, Polyester net, TCC Kapton etc.) on a large table and cut to the required lengths.
- Inspect the layers for any defects such as aluminium coating degradation, contamination, and any physical damages. Avoid those areas while cutting.
- Compile the different layers one over the other as per the MLI configuration types.
- Pins and clips may be used to hold the bunch of layers together for storing, handling and for further fabrication.
- Label the blankets with their layers configuration type.

3) MARKING THE GEOMETRICAL LAYOUT:

- Mark the geometrical layout of the blanket to be fabricated on the bottom cover of the rough size blanket using template or fabrication drawing.

4) GROUNDING:

- Identify the electrical grounding point locations on the geometrical layout.
- At the grounding point locations make L type slits in the polyester net layers to facilitate fixing of grounding tape to the MLI layers.
- Fix aluminium grounding tape of one inch width on both sides of the Mylar layers and Kapton layers in a Z fashion, continuously, to form grounding tab of size one inch by one inch.
- Punch a hole of 4mm diameter in the grounding tab approximately at the centre.
- Insert the brass washers, aluminium rivet of 4mm diameter, grounding wire with lug and rivet it.

5) STITCHING:

- Identify the stitching points, as per the MLI blanket template/fabrication drawing, and stitch the layers with Teflon buttons and nylon thread. The Teflon buttons

must be placed on either side of the MLI blanket. The stitching knot should appear on the bottom cover of the MLI blanket. The knot should not compress the blanket layers excessively at the same time the layers should not be held loose. After stitching, cut the excess thread leaving 2.5 cm from the knot. While stitching, make sure that excessive wrinkles on the blanket are not formed.

6) CUTTING AND EDGE SEALING:

- Cut the MLI blanket as per the geometrical layout. This includes cutting the blanket edges, incorporating slits and cut-outs.
- Fix plain Kapton adhesive tapes at the corners of the cut-outs and at the end points of the slits, on both sides of the blanket. Seal the edges and cut-outs with self adhesive Kapton tape as per the template/drawing.

7) BONDING VELCRO TAPES ON MLI BLANKETS:

- Identify the Loop Velcro tape locations on the bottom cover and Hook Velcro tapes on the top cover.
- Make sure the bonding surface areas on the blanket and Velcro tapes are clean.
- Place the MLI blanket on the worktable in such a way that the bottom cover of the blanket faces upwards.
- Apply one coat of adhesive on the rear side of the Loop Velcro tapes with brush and allow it to dry for ten minutes so that the adhesive becomes tacky.
- Apply one more coat of adhesive on the Loop Velcro tape and stick the Loop Velcro tapes on the bottom cover / layer of the MLI blanket.
- Place aluminium plates over the Loop Velcro tapes and keep dead weights over the aluminium plates and allow the adhesive to cure for 12 hours at room temperature.
- Remove the dead weights and aluminium plates after 12 hours of curing
- Reverse the MLI blanket on the table in such a way that the top cover faces upwards.
- Apply one coat of adhesive on the rear side of the Hook Velcro tapes with brush and allow it to dry for ten minutes so that the adhesive becomes tacky.
- Apply one more coat of adhesive on the Hook Velcro tape and stick the Hook Velcro tapes on the top cover / layer of the MLI blanket.
- Place aluminium plates over the Hook Velcro tapes and keep dead weights over the aluminium plates and allow the adhesive to cure for 12 hours at room temperature.
- Remove the dead weights and aluminium plates after 12 hours of curing.

Note: The velcro tape bonding procedure, curing time and temperature may vary depending upon the adhesive used. Follow the specified bonding procedure, if any.

ASSEMBLY: The blankets so fabricated are mounted on the spacecraft in clean room.

7.11 STEPS FOR HEAT SHIELDS FABRICATION

(1a) LAM HEAT SHIELD FABRICATION : This involves the cutting of radiation metallic foils of Titanium material with scissors to the required geometry & fixing of ceramic beads at selected points. This activity is carried out at laboratory level.

(1b) LAM HEAT SHIELD ASSEMBLY : This involves the assembly of primary shield assembly by means of fastening & assembly of radiation foils using conical parts with top disc. For covering the top disc, titanium wire is used and entire assembly is integrated to the LAM deck. This is carried out at spacecraft level in clean room.

(2a) AOCS HEAT SHIELD FABRICATION : This involves the cutting of radiation metallic foils such as stainless steel (SS), titanium & tantalum materials with scissors to the required geometry, fixing of ceramic beads at selected points & attaching the connecting angles to the outer layer (SS) with spot welding. This activity is carried out at laboratory level.

(2b) AOCS HEAT SHIELD ASSEMBLY : This involves the assembly of radiation foils using SS wire and entire assembly is integrated on to the thrusters bracket by means of fastening. This is carried out at spacecraft level in clean room.

8.0 MATERIALS, CONSUMABLES, TOOLS AND EQUIPMENT:

Implementation drawings and thermal control elements shall be supplied along with spacecraft component.

All the consumables like cleaning solvents, wiping materials, finger cots etc. required for carrying out the work shall be supplied. It is the responsibility of the contractor to use them judiciously.

The tools, scissors, surgical blades, knives etc., needed for carrying out the activities shall be supplied. The contractor has to account them and return them at the end of the work.

The equipment required for inspection shall be supplied. It is the responsibility of the contractors to return them back in safe working condition.

9.0 GENERAL SAFETY PRECAUTIONS / WORK INSTRUCTIONS

The contractor personnel should strictly adhere to the general work rules, procedures and office timings followed at ISAC and keep cordial relations with ISAC staff during their visit to ISAC.

The thermal fabrication & implementation activities involve handling of very thin metallic coated foils, metallic coated fragile parts, chemicals, adhesives, etc. The thermal control elements and other materials associated with the implementation works are very delicate, expensive and prone to be contaminated and damaged if not handled carefully. While carrying out the electro-chemical operations on spacecraft components, if the processes are not carried out carefully, the parts may get dissolved or damaged in chemical baths. The activities are single shot operations. In addition to the handling of thermal control elements, the personnel have to handle delicate electronic packages that are sensitive to electro static discharge. It is skilled activity and should be done by skilled manpower.

The following are the general precautions and work instructions to be observed while carrying out the thermal works:

- Wear clean room garments in thermal laboratories and spacecraft integration clean rooms.
- Do not touch the components / packages and thermal control elements with bare hands. Wear lint free gloves or powder free finger cots. Use nose and mouth masks while working on rigid OSRs in addition to the hand gloves / finger cots.
- Do not shake hands with others after wearing gloves or finger cots.
- Wear electrical grounding wrist strap while handling the electronic packages and working on the spacecraft.
- Check for the correct solvent for cleaning the substrates and thermal control elements by verifying the label of the solvent container.
- Check the expiry date for shelf life of the adhesives, solvents and chemicals before use.
- Use approved laboratory grade solvents for cleaning the substrates.
- Use approved optical grade isopropyl alcohol for cleaning the thermal control elements.
- Do not use excessive chemical solvents for cleaning operation. Make sure that no solvent seeps inside the packages or panel inserts etc.
- Check for QA clearance certificates for thermal operations on the packages subsystems etc.
- Check with the concerned thermal personnel / integration personnel before carrying out thermal operations on the spacecraft.

- Do not lean on the spacecraft or make use of spacecraft for support while working on the spacecraft or near the spacecraft.
- Watch the surroundings and avoid brisk movements near the spacecraft to avoid injuries, entangling with the spacecraft wire harnesses and damaging the spacecraft.
- Do not enter spacecraft integration clean rooms or clean areas of thermal laboratories if you are suffering from cold or cough.

10.0 MANPOWER REQUIREMENT:

Personnel deputed for carrying out these activities shall be “Skilled -Trained Personnel” with experience of about 5 years in aerospace and allied industries and able to communicate in English and Kannada languages. They should be able to work most of the time in standing posture. They must also have the aptitude to follow the prescribed clean room work conditions, material / equipment handling procedures and any other instructions given to them.

Based on the past experience and the work, the manpower estimation and their qualifications required are given below:

Electro-chemical Works at EC Laboratories in LPSC Campus:

- One engineer with B.E (Chem) or M.Sc (Chemistry) qualification.
- Two diploma holders (Chem)
- Three ITI personnel (Electro plating trade)

MLI Works, OSR, Heaters, Tapes, Painting etc. at ISAC:

- Two engineers with B.E (Mechanical) qualification.
- Five Diploma holders (Mech)
- Two ITI personnel (Electrical)
- Ten ITI personnel (Fitter)

B.E and diploma holders shall have the knowledge of Unigraphics (UG). One of the

Mechanical Engineer is required to perform overall supervision of thermal activities and coordination activities in addition to regular implementation activities.

On summary, the following candidates are required:

- a) Engineers (BE / MSc) 3 No
- b) Diploma Holders.....7 No.

c) Technicians.....15 No.
Total.....25 No.

Note Since contract manpower will be trained by ISRO for specific skills for meeting high quality requirement, the contractor shall ensure that the ISRO trained manpower is available through the period of contract.

Contractor with ISRO trained manpower should depute the same personnel trained in the previous contracts and shall retain all the trained personnel and depute the same personnel throughout the contract period of 2 years.

11.0 CONTRACT PERIOD:

Two years from the date of deputing all the personnel after receipt the work order.

12.0 PRICING:

The party should quote for the thermal fabrication & implementation works mentioned in para 4.0 as per the details given below:

- Electro-chemical process:
 - For each small size component
 - For each medium size component
 - For each big size component
- Each square meter of thermal control paint applied.
- Each OSR bonded.
- Each foil heater fixed.
- Each meter length of tape heater fixed.
- Each thermistor / PRT bonded.
- Each square meter of thermal control tape fixed.
- Each package/component applied with thermal conductive grease applied
- Each square meter of MLI blankets fabricated and mounted
- Each AOCS heat shield fabricated and assembled
- Each LAM heat shield fabricated and assembled

13.0 Mode of Certification for Payment:

Based on the work carried out by the contractor's team under each of the work head defined above, monthly certification/quarterly certification for release of payment will be made.

14.0 INSTRUCTIONS TO CONTRACTORS:

1. Salary Structure : Salaries per month (for 26 working days of 8 hours a day, assumed to be working for 30 days) recommended to the contract employees by ISRO Satellite Centre through Works Contract Order is indicated below:

- **Engineer (B.E) : Rs 19500/-**
- **Tech Asst (Diploma) : Rs 12750/-**
- **Technician (ITI) : Rs 7500/-**

2. Contributions towards PF & ESI : 13.61% & 4.75% respectively (Total : 18.36%)

3. Incidental charges of Contractor : As indicated below.

4. Service charge (Tax): Service charge of 10.3% is applicable on sl no. 1 to 3.

Following shall be included under Incidental charges : (Break-up shall be indicated)

- **Profit / Service Charges : A reasonable amount towards service rendered shall be indicated.**
- **Police verification certificate: ISAC is a highly protected government place and as such personnel working at ISAC shall have good character & conduct. So Man-power supplier shall necessarily obtain a Certificate of Conduct for each of their staff from the Police Authority to the effect that the workers so deputed are free from any sort of crimes, etc immediately after placing order.**
- **Uniform charges : Man-power supplier shall provide uniform clothings (consisting of half sleeve shirt & pant) to all their employees and instruct all their employees to wear the uniform compulsorily on all working days. Soiled & torn uniforms shall not be worn.**

Note:

- Man-power suppliers while submitting the quotations shall strictly consider all the above points.
- Salary structure indicated above is the consolidated monthly salary paid to the contract employees and no other allowances are paid.
- Total amount of sl No 1 to 4 during the period of two years contract shall be equivalent to total amount calculated for the quantum of works contract and these shall be included in the quotation. If not, the quotation will be rejected.
- Some contract employees during the period of works contract, will have to be deputed to other Centres of ISRO for spacecraft launch activities or testing of components, etc and the charges (TA & DA) for these will be borne by ISAC.
- Contractor shall prepare the daily log of quantity of thermal works carried out by their employees, prepare a consolidated sheet of the same for every month which shall be signed & approved by the focal point and submit the same alongwith bill prepared for the same once in a month to Accounts Officer, ISAC for making payment.
- All the work orders or contracts awarded to a new contractor should be initially for a period of three months and extended upto two years, subjected to satisfactory performance. Contractor should immediately replace unsatisfactory candidate.
- ISRO would like go through the bio-data of proposed man-power and have interaction with them before admitting them into our office/work.

----- END OF STATEMENT OF WORK -----

APPENDIX-1 to FM018

01. PERIOD OF SERVICE CONTRACT: TWO YEARS

2. Skill level required for executing the Service Contract:

Sl. No.	No. of work force for executing the Service Contract	Skill level required for executing the Service Contract (qualification, experience, etc.)
1.	01 NO 02 NOS	BE (Chem.) /MSc (Chemistry) BE (Mechanical)
2.	02 NOS 05 NOS	Diploma Holders(Chem) Diploma Holder (Mechanical) _
3.	03 NOS 02 NOS 10 NOS	ITI Personnel (Electro Plating trade) ITI Personnel (Electrical) ITI Personnel (Fitter)

3. The Minimum Service Charges (including D.A.) payable per day/month for the various categories

Sl. No.	Category & Competency / Skill-level required	Service Charge payable per day (8 hrs)	Service Charges payable for a month (in case of 26 Working days)
1.	Skilled Manpower (ITI etc) Technicians	Rs.250/-	Rs.7,500/-
2.	Technical Personnel DME (Mechanical)	Rs.425/-	Rs.12,750/-
3.	Technical Personnel (BE, MSc. etc)	Rs.650/-	Rs.19,500/-

SL.NO. 11

FILE NO. ISIP2010019251

**DESCRIPTION OF ITEM : FORCE TRANSDUCERS AND
DIGITAL PRECISION MEASURING AMPLIFIER.**

QUANTITY :

FORCE TRANSDUCER : 20 KN	- 04 NOS
FORCE TRANSDUCER : 50 KN	- 04 NOS
DIGITAL PRECISION MEASURING AMPLIFIER WITH ACCESSORIES.	- 01 NO.

A) Specification for Force Transducer — (Quantity: 4 Nos.)

- | | |
|--|---------------------------|
| 1. Nominal (rated) Force (F_{nom}) | : 20 kN |
| 2. Accuracy Class | : 00 |
| 3. Nominal sensitivity (C_{nom}) | : 2 mV/V |
| rel. sensitivity deviation, d_c | : 0.1% |
| rel. tensile/compressive force sensitivity diff., d_{zd} | : 0.2% |
| zero signal tolerance, $d_{s,0}$ | : 0.5% |
| rel. zero point compensation (zero signal return), f_0 | : 0.08% |
| 4. Rel. range (0.2 F_{nom} to F_{nom}) at : | |
| Unchanged mounting position, typically, b_1 | : 0.02% |
| Different mounting positions, typically, b | : 0.03% |
| Rel. range of inversion (0.2 F_{nom} - F_{nom}), u | : 0.06% |
| 5. Linearity deviation, d_{lin} | : 0.02% |
| 6. Effect of temperature on sensitivity/10 K | |
| By reference to nominal sensitivity, TK_c | : 0.01% |
| 7. Effect of temperature on zero signal/10 K | |
| By reference to nominal sensitivity, TK_0 | : 0.015% |
| 8. Effect of Transverse forces (Transverse forces 10% F_{nom}), d_Q | : 0.03% |
| 9. Effect of Eccentricity per mm, d_E | : 0.01% |
| 10. Rel. creep over 30 min., d_{crF+E} | : 0.02% |
| 11. Input resistance, R_e | : >345 ohm. |
| 12. Output resistance, R_a | : 356+/-0.3 ohm. |
| 13. Isolation resistance, R_{is} | : >5.10 ⁹ ohm. |
| 14. Reference excitation voltage, U_{ref} | : 5 V |
| 15. Operating range of the excitation voltage, $B_{U,G}$ | : 0.5...12 V |

16. Nominal temperature range, $B_{t,nom}$: +10...+40 °C
17. Operating temperature range, $B_{t,G}$: -30...+85 °C
18. Storage temperature range, $B_{t,S}$: -50...+85 °C
19. Reference temperature, t_{ref}	: +22 °C
20. Max. operational force (F_G)	: 150%
21. Limit force (F_L)	: 150%
22. Breaking force (F_B)	: 250%
23. Static lateral limit force (F_Q)	: 30%
24. Limit torque, M_G	: 120 N-m
25. Nominal displacement, S_{nom}	: 0.2 mm
26. Fundamental resonant frequency, f_G	: 4.1 kHz
27. Weight	: 1.8 kg
28. Rel. permissible vibrational stress, F_{rb}	: 70%
29. Cable length, six-wire connection	: 16 meters
30. Degree of protection to DIN EN60529	: IP 67

Calibration Certificate for “20kN” Force Transducers: (Quantity: 4 Nos)

1. DKD Calibration Certificate for force acc. to ISO 376, up to 25 kN with cable length = 16m, Type of load: Compression, single bridge.

B) Specification for Force Transducer – (Quantity: 4 Nos.)

1. Nominal (rated) Force (F_{nom})	: 50 kN
2. Accuracy Class	: 00
3. Nominal sensitivity (C_{nom})	: 2 mV/V
rel. sensitivity deviation, d_c	: 0.1%
rel. tensile/compressive force sensitivity diff., d_{zd}	: 0.2%
zero signal tolerance, $d_{s,0}$: 0.5%
rel. zero point compensation (zero signal return), f_0	: 0.08%
4. Rel. range (0.2 F_{nom} to F_{nom}) at :	
Unchanged mounting position, typically, b_1	: 0.02%
Different mounting positions, typically, b	: 0.03%
Rel. range of inversion (0.2 F_{nom} - F_{nom}), u	: 0.06%
5. Linearity deviation, d_{lm}	: 0.02%
6. Effect of temperature on sensitivity/10 K	
By reference to nominal sensitivity, TK_c	: 0.01%
7. Effect of temperature on zero signal/10 K	
By reference to nominal sensitivity, TK_0	: 0.015%
8. Effect of Transverse forces (Transverse forces 10% F_{nom}), d_Q	: 0.03%
9. Effect of Eccentricity per mm, d_E	: 0.01%
10. Rel. creep over 30 min., d_{crF+E}	: 0.02%
11. Input resistance, R_e	: >345 ohm.
12. Output resistance, R_a	: 356+/-0.3 ohm.
13. Isolation resistance, R_{is}	: >5.10 ⁹ ohm.

14. Reference excitation voltage, U_{ref}	: 5 V
15. Operating range of the excitation voltage, $B_{U,G}$: 0.5...12 V
16. Nominal temperature range, $B_{t,nom}$: +10...+40 °C
17. Operating temperature range, $B_{t,G}$: -30...+85 °C
18. Storage temperature range, $B_{t,S}$: -50...+85 °C
19. Reference temperature, t_{ref}	: +22 °C
20. Max. operational force (F_G)	: 150%
21. Limit force (F_L)	: 150%
22. Breaking force (F_B)	: 250%
23. Static lateral limit force (F_Q)	: 30%
24. Limit torque, M_G	: 350 N-m
25. Nominal displacement, S_{nom}	: 0.2 mm
26. Fundamental resonant frequency, f_G	: 4.5 kHz
27. Weight	: 2.4 kg
28. Rel. permissible vibrational stress, F_{rb}	: 70%
29. Cable length, six-wire connection	: 16 meters
30. Degree of protection to DIN EN60529	: IP 67

Calibration Certificate for “50kN” Force Transducers: (Quantity: 4 Nos.)

1. DKD Calibration Certificate for force acc. to ISO 376, calibration for 50 kN with cable length = 16m, Type of load: Compression, single bridge.
2. DKD Calibration Certificate for force acc. to ISO 376, calibration for 30 kN with cable length = 16m, Type of load: Compression, single bridge.

C) Specification for Digital Precision Measuring Amplifier – (Quantity: 1 No.)

1. Accuracy class	: 0.0005
2. Number of amplifiers	: 2
3. Transducers that can be connected	: 2 x 8 SG full bridges
4. Transducer excitation voltage U_b	: 2.5 V; 5 V; 10 V
5. Carrier frequency	: 225+/-100 ppm Hz
6. Transducer resistance per amplifier	
At $U_b = 2.5V; 5V$: 30...2000 ohm
At $U_b = 10 V$: 60...4000 ohm
7. Transducer cable length	: <200 m
8. Measurement ranges	: +/-2.5 mV/V; +/-5 mV/V; +/-10 mV/V
9. Digital filters upto 16 th order	: 10...0.03 (15 steps) Hz
10. Display resolution	: >1000000 digit
11. Common-mode rejection	: >120dB
12. Input resistance	: 10 M ohm
13. Sampling range per amplifier	: 1.2...75 1/s
14. Tare range	: total measurement range
15. Linearization of transducer characteristic	: 2...11 Points

16. Linearity deviation	
Referred to full scale value	: <0.0005%
17. Influence of a 10 K change in nom. Temperature range	
On the zero point (Referred to full scale value)	: <0.0002%
On sensitivity (Referred to full scale value)	: <0.0005%
18. Short –term drift over 5min, after 2 h warm up	: max. +/-2, typ. +/-1 ppm
19. Long –term drift over 24 h, after 2 h warm up	: max. +/-5, typ. +/-2 ppm
20. Nominal temperature range	: 0...+40 °C
21. Operating temperature range	: 0...+50 °C
22. Storage temperature range	: -10...+60 °C
23. Operating voltage (mains voltage)	: 230 (115) +/- 10% (50...60 Hz) V
24. Power consumption	: approx. 60 VA
25. Weight	: approx. 15 kg
26. Dimensions (W x H x D)	: 458 x 171 x 367 mm
27. Connection for	
Transducers	: 2 x 8 x DB-15S
Limit outputs, control signal inputs	: DB-25S
Computer interface RS-232	: DB-9S
Computer interface RS-422/485	: DB-9S
Computer interface IEEE-488	: 24 pin cannon

Calibration certificate for Amplifier: (Quantity: 1No.)

1. DKD Calibration Certificate for voltage ratio according to Standards (-100 - 0/0/10/20/...../90/100 %)

Accessories for Amplifier:

S.No	Description	Quantity (No.)
01	RS-232-Adapter cable, for connection with PC, 9-pole D-plug socket to 9-pole D-plug, 3m	01
02	IEEE488-Bus cable, 24-pole standard plug, 2m	02
03	Synchronization cable	01
04	Mounting of MS plug on Z4A	08
05	Extension cable for Z4A, MS connectors, 10m	08
06	Adaptor MS connector to D-Sub to connect Amplifier	08

Note: -

- i. All the supplied standard accessories including warranty should be mentioned clearly in quotation.
- ii. Test and calibration certificate of the equipments should be supplied.
- iii. All hardware and software user manual to be supplied
- iv. The vendor should provide original manufacturer's certificate to be submitted along with quote. Also, servicing and training to be extended indigenously in India.

SL.NO. 12

FILE NO. ISIP2010019250

DESCRIPTION OF ITEM : LOW PROFILE WEIGHTING SCALE .

QUANTITY : 06 NOS.

ANNEXURE I

Technical Specification

Aim

The Low Profile Weighing Scale (LPWS) is required for weighing spacecrafts during its assembly and integration phase to monitor the mass growth.

Description

Low Profile Weighing Scale (LPWS), is a weighing plate of shallow construction. Satellite Assembly Fixture is featured with three wheels (2 fixed and 1 steerable) to enable mobility along with satellite. Three LPWS are mounted below each of the three wheels of Satellite assembly fixture. Fig. 2 shows arrangement of scales to be used for measurement of weight considering center of mass of object being weighed. The proposed scale need to be of highly accurate and must contain display unit on the weighing plate itself for the quick reading of data.

Low Profile Weighing Scale Specification

S. No.	Parameter	Low Profile Weighing Scale Qty: 6 Nos.	Compliance with Specification (To be Specified by vendor)
	Weighing Range	5000 kg/50 kN capacity	
2	a) Calibration Standard	ASTM E7442 (Class AA) or ISO 376:2004 (Class 0.5)	
	b) Uncertainty of applied calibration force as per 2(a)	0.02%	
	c) Resolution as per 2(a)	0.05 Kg	
3	Operating Temperature Range	0° C to 50° C	
Weighing Surface Dimension or Nearest Dimension (Refer Fig. 1)			
4	Length (l)	2" to 16" 500mm to 400mm	

5	Width (w)	12" to 16" (300mm to 400mm)	
6	Height (h)	< 1"	
Overall Surface Dimension or Nearest Dimension (Refer Fig. 1)			
7	Length (L)	20" to 25" (500mm to 625mm)	
8	Width (W)	16" to 18" (400mm to 500mm)	
9	Height (H)	< 1.5"	
11	Display	Liquid Crystal Display (LCD)	
10	Power	a) Standard replaceable rechargeable batteries preferably NiMH Li Ion	
		c) Built in protection safety feature in equipment to avoid overcharge of battery	
		b) Battery Capacity: 8-12 hrs run time of equipment on single recharge of battery	
12	PC Connectivity	Computer interface along with necessary interface cable (RS232 LSH) and operating software	

ACCESSORIES

1. Additional accessories/spares (such as charger, ramp, storage case etc), operating software are to be listed and quoted separately giving complete tech spec and details.
2. Quantity of accessories, spares required are to be clearly indicated.
3. Operating manual giving operation and calibration procedure, maintenance etc is to be supplied.

IMPORTANT

1. The specifications mentioned above are minimum requirement.
2. Calibration certificates are to be supplied along with the equipments.
3. Specification of batteries or any consumable/ replaceable parts used are to be clearly stated.

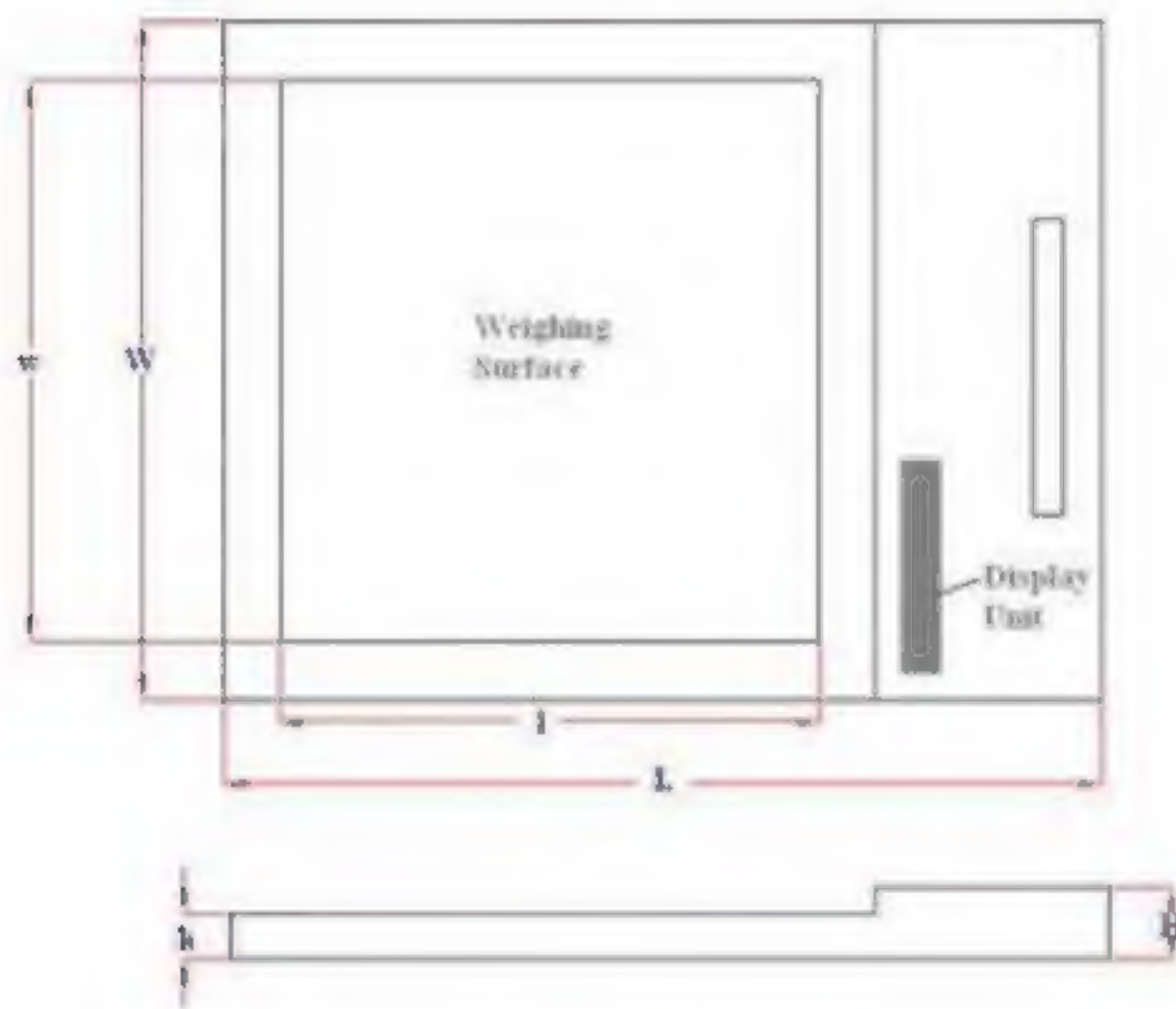


Fig 1

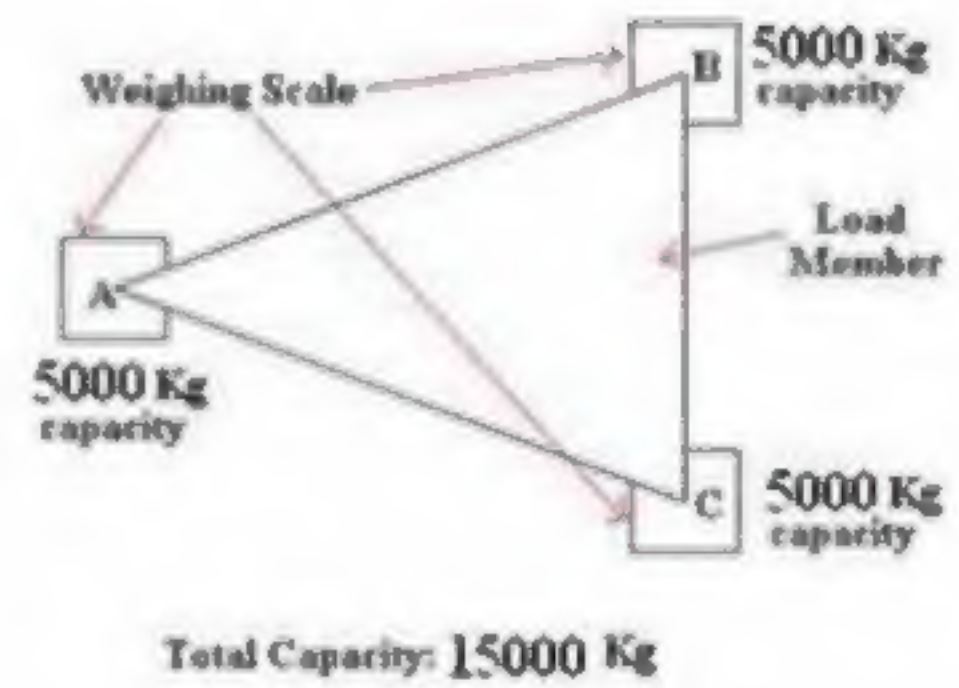


Fig. 2
Proposed configuration for the use of LPWS

SPECIAL INSTRUCTIONS FOR 2 PART TENDER

This should consist of two sections viz., (a) Technical and
(b) Commercial

PART I (TECHNICAL AND COMMERCIAL PART):

(a) Technical: This section should consist of:

- All technical specifications of the items options and accessories offered by you.
- Relevant leaflets and literature and any other technical matter pertaining to the items offered.

(b) Commercial: All the commercial points to be indicated (other than prices) should come in this section for example:

Delivery terms and delivery period, Payment terms (our standard Terms i.e. 100% Payment within 30 days after receipt and Acceptance)

- Validity period of the offer (120 days required)
- Warranty / Guarantee applicable
- Installation details such as installation is done Free of cost or not
- If not indicate "installation charges indicated in Price part".
- Whether training is required; if so, free of cost, if not indicate "training charges indicated in price part"/

"Approximate weight of the consignment".

Note: (1) Part 1 prepared as above should be Enveloped and Superscribed Technical & Commercial part 1

Reference No:

Due date :

Note: (2) Part 1 should not contain any price details

Contd.../-

PART II (PRICE PART)

This part should consist of:

- Prices of the unit and total amount for the items offered (with break-up wherever required):
Price of option and accessories Installation charges & Training (if not free)
Where the quotation is on Ex-works basis Packing forwarding and inland freight charges if any Price part (Part II) thus prepared should be Enveloped separately and superscripted as.

Price part II

Reference No:

Due date :

Note: (3) Both the envelopes (Part 1 and Part II)

Prepared as above should be placed in another envelope and superscribed as follows:

Reference No:

Due date :

Part 1 & Part II individually enveloped inside:

TO:

THE HEAD, PURCHASE AND STORES
ISRO SATELLITE CENTRE
GOVERNMENT OF INDIA
DEPARTMENT OF SPACE
AIRPORT ROAD
VIMANAPURA POST
BANGALORE-560 017.

Note: (4) The above should reach us on or before the due date and time.

Note: (5) HEAD, PURCHASE AND STORES, ISRO SATELLITE CENTRE, GOVERNMENT OF INDIA, DEPARTMENT OF SPACE. AIRPORT ROAD, VIMANAPURA POST, BANGALORE - 560 017. RESERVES THE RIGHT OF ACCEPT OR REJECT ANY OF THE QUOTATION IN FULL/ PART THEREOF WITHOUT ASSIGNING ANY REASONS

